PEARL

# The Journal of HEREDITY

FOURTH GENERATION OF WHITE FORELOCKS

(SEE PAGE 67)

Short Ring Fingers Inherited

Neanthe—A Palm-Drosophila

A Half Hen-feathered Rooster

Swedish and American Eugenics

Population Trends and Eugenics

A New Lethal Jaw-defect in Cattle

Eugenics and the Art of Motherhood

VOLUME 30 MARCH, 1939 NUMBER 3

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# Journal of Heredity

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**FRONTAL BLAZE IN SECOND AND THIRD GENERATIONS**

**Frontispiece**

Photographs from two generations of a Norwegian family which for four generations has shown white forelocks and skin spotting. The numbers refer to the pedigree chart (Figure 3). The father of 1.2 and 1.6, whose mother "was frightened by a white horse," was the first recorded individual to show the piebald characteristic. The eyebrows of 16.6, as well as the large triangular forelock, are white.

# A PEDIGREE OF SKIN-SPOTTING IN MAN

## 42 Piebalds in a Norwegian Family

HANS SUNDFÖR

*Maternity Hospital, Bergen, Norway*

ON September 27, 1936, a girl child was born at the Maternity Hospital in Bergen who aroused considerable interest because of her unusual hair. It was mostly blond, but in a broad band which narrowed as it went back from the forehead to the crown of the head, the hair was pure white, completely without pigment (Figure 2). The mother had a similar large white forelock but had clipped it so that it was noticeable only when her hair was disarranged.

At the suggestion of Dr. L. Severin Petersen I questioned the mother and learned that the white forelock was quite common in her family. The information I gathered from correspondence with several of her relatives seemed to indicate that it was a case of simple dominant inheritance. Prof. O. L. Mohr, whom I consulted, informed me that the anomaly was very rare and deserved a careful investigation. With financial assistance from Dr. Alexander Malthes' legacy, I collected the following material during the summer of 1937.

Practically the entire family lives in the district around Bergen, so that it has been possible to come in direct contact with almost all of the now living members of the family in which the anomaly is found. The large majority of these people showed great interest in my work and kindly cooperated in giving me information although they are rather self-conscious because of their unusual appearance. The district where they live is rather primitive, and without the hospitable reception they gave me, providing both food and lodging, it would have been very difficult to carry on my investigations.

I am very grateful to Prof. Mohr who has helped me with advice and suggestions, and to the Dr. Alexander Malthes Fund for covering traveling and other incidental expenses.

### Description of the Pigment Anomaly

The most striking feature is the white forelock, but besides this most of the affected individuals have unpigmented spots on the body and limbs. The anomaly is congenital; the white forelock is clearly apparent at birth. The first I saw was only a few hours old. The unpigmented spots on the skin do not appear until the regions have been exposed to the light, but they do not change their contours, that is they retain the same relative size as the children grow older and never spread to new areas which were originally normally pigmented.

The white hair grows in a symmetrical triangle with its base at the hair line of the forehead and the apex pointing back towards the crown. Occasionally the hair is white all the way back to the vertex, and once I found only a few white hairs just at the hair line. Usually the triangle has a height of six to eight cm. in adults.

Quite frequently the skin of the forehead below the white forelock is unpigmented (Figure 1, 161.5), occasionally all the way down to the eyebrows. The same holds true for this spot as for the rest of the white spots on the body and limbs, that "never become brown, even when exposed to the strongest sunlight" as one of the family expressed it.

It is quite common that the mid-portion of the eyebrows is white but in only one individual (Frontis. 16.6) were they completely white. The white in the eyebrows is not continuous with the white on the forehead but they are isolated un-

**PIEBALDS IN THE FOURTH GENERATION**

**Figure 1**

Individuals heterozygous for the dominant piebald gene. Except for the lack of pigment, these people are entirely normal. Since there have been no marriages of two affected persons, the gene has never been observed in the homozygous state. The observed ratio of affected and normal children from such "backcross" marriages to normal is 41 affected to 30 normal, where equality in numbers is expected. (See pedigree chart, Figure 3, for relationships.)

**WHITE FORELOCKS AND FOREHEADS**

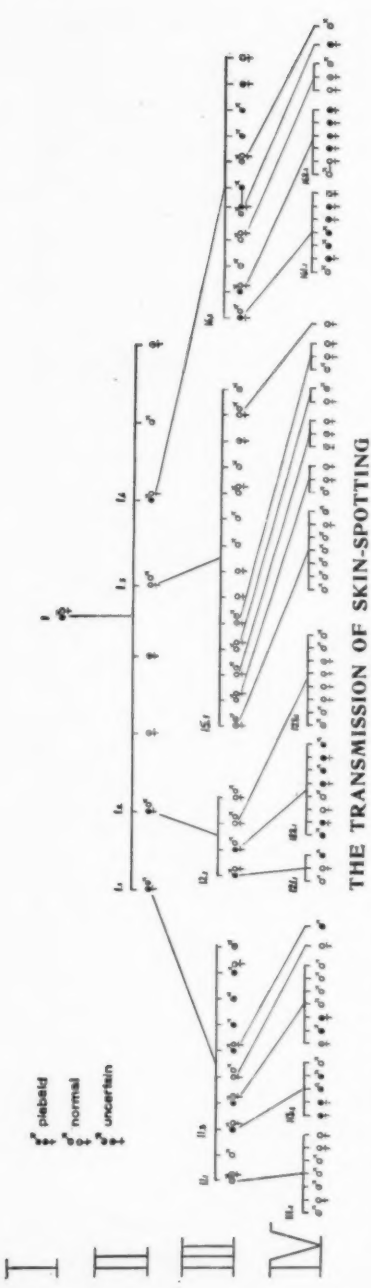
**Figure 2**

Fourth generation children showing the character. The first individual to be observed in this study was 165.1, a girl born in 1936. The extension of the unpigmented area down the forehead is noticeable in 113.4.

pigmented spots. White eyelashes have never been observed. Several of the men have a little white beard under the chin.

On the body it is often more difficult to determine how large the unpigmented spots are. If the skin has not been exposed to the sun, there is no well defined difference between the pigmented and the unpigmented skin. The white skin has exactly the same appearance as the normal regions, but lacks the ability to form pigment when exposed to the sun. The contrast does not appear clearly until the surrounding areas have been sunburned. The only difference which is always observable is that any hair which grows on the unpigmented areas is white. Because of this circumstance it has often been difficult to determine the contours accurately. The contrast is poorest on the upper part of the chest and on the thighs. On the back of the thighs it has never been possible to determine any contours with certainty. It has also been difficult to determine the borderline between normal and unpigmented skin on the upper arm.

All individuals who were slightly sunburned had an unpigmented area on the chest and abdomen (Figure 6). This has been so constant that I believe it is present in all the affected individuals although I cannot state with certainty that all of those with very fair skin would show spots on the body if they exposed themselves to the sun. This white area usually begins just above the papillae and extends downward to a point between the symphysis and the umbilicus. On the sides the border follows the inner axillary line or is slightly more median. I have never seen it extend around to the back. The lower border is generally very sharply defined, here it appears as




THE TRANSMISSION OF SKIN-SPOTTING

Figure 3

Four generations of the family with the white forelock and unpigmented areas on the body. For description of the method of numbering, see the text on the opposite page. For patterns of some of the piebald individuals, see the accompanying figures.

if the pigment is crowded out of the white area and concentrated on the border so that the skin at this point is browner than usual. The contrast in most cases is also sharp along the sides but on the chest the transition is more gradual.

On the limbs I also believe that almost all affected individuals have unpigmented spots (Figures 4, 5, and 6) even though many of them have protected their skin so well against the sun that nothing shows. Among many of these the hairs on the legs have been partly white. On the medial side of the arms there is a white band of varying breadth. It can possibly be totally lacking in some few cases but in others completely encircles the arm (Cf. 114.3, Figure 4). It is quite common that the band extends in a wedge form in a lateral direction on the back of the elbow.

Most of the individuals have a white band around the lower extremities but this can be almost completely lacking in some instances (Cf. 114.2, Figure 6). The lower contour is sharply defined, crossing the calf or ankle obliquely, from the outer and upper to the inner lower side of the leg (Figures 5 and 6). On the thighs the border is less well defined. Sometimes it is directly above the knee but in some cases the white on the front of the thigh merges with the white on the abdomen. Contours of the unpigmented areas are presented in Figure 6. I have not made drawings from the dorsal side as the back is always normal and, as mentioned above, the contours on the back of the thighs are almost impossible to determine.

Within the large white areas there often are pigmented spots of varying size; these are frequently darker than the normal skin and are most numerous near the borders of the unpigmented areas. A great many of the affected individuals are very strongly freckled. I was not aware of this circumstance until a late stage of my investigation and cannot say with certainty whether they are more freckled than their normal siblings.

### Collection of Data

My first information of the family was obtained by correspondence. This was merely done as preparation. All information was later controlled and corrected personally.

There are in all 42 individuals in this family who have had the anomaly. All of the 36 now living I have personally seen and examined. These affected individuals have had 30 normal siblings. Of the 24 now living I have seen and examined 20. As far as possible I have photographed all those with the white forelock, and I have borrowed some family pictures of a couple of second generation individuals. As most of the family are blond, it has often been difficult to make the white forelock appear clearly in the photographs. The color contrast between normal and unpigmented skin on the body is never so sharp that it is possible to photograph it. Instead I have made some schematic drawings. Where the contrast was sharp I have drawn sharp lines, where the borderline was less marked I have tried to indicate this by gradual shading. In Figure 6 I have included only the drawings of those individuals where the contrast was comparatively pronounced.

None of them refused to allow themselves to be photographed, but many were rather shy about letting me make drawings of their body patterns. This was especially true of the women. I have made a thorough examination of only one of them. Most of them said that when they were sunburned they looked about like one of the small children whom they showed me.

Of the six affected individuals who are dead and whom I have not seen, the information I have obtained is reliable. The first is the original male ancestor of the whole family and is well remembered by his children; the others have living parents and siblings who are certain that the deceased were affected. In cases where I have received conflicting reports I have recorded the individuals as uncertain. There are five of these.

In order to determine whether there is any relation between the anomaly and hair or eye color, I have classified these after Eugen Fischer and Rud. Martin respectively. Most classifications are rather uncertain as the colors were identical with the samples in only a very few cases. The result of this investigation is given in Table I together with the initials and dates of birth and death of the individual members of the family.

### Description of the Family

I have made use of the system of Mohr and Wriedt[3] to indicate the members of the family. Each individual is given a number corresponding to his order of birth in his fraternity. His offspring have the same number plus their own ordinal number. Since in some families there are more than 10 children, a period is always placed before the fraternity number of each individual. Thus the first piebald member of the present family is 1. His offspring are 1.1, 1.2, 1.3, etc., to 1.8. The offspring of 1.1 are 11.1, 11.2, etc.; of 1.6: 16.1, 16.2, etc. Only initials and year of birth and death will be used to mark the individuals. In the pedigree (Figure 3) males and females are marked in the usual manner with ♂ and ♀, those having the anomaly are marked with a black circle, those who are uncertain are indicated by a black dot within the circle.

### The Pedigree (Figure 3)

The first individual who had the white forelock was Nils Rősland. He was born on the Rősland farm on Osterőy near Bergen in 1836 and died in 1894. The story has been handed down that his mother was frightened by a white horse while she was carrying him and she herself was certain that this incident was responsible for his being born with a white forelock. Some members of the family still accept this explanation but most of them were less credulous and were not surprised when I told them that the white horse had nothing to do with the color of their hair.

Both of Nils' parents were normally pigmented. Aside from this family there are no individuals in the vicinity with a white forelock. As far as is known Nils

**SPOTS ON ARMS**

**Figure 4**

Photograph showing unpigmented areas on arms of 114.3 (Figures 1, 3, and 6.)

Rősland's mother had never been outside of the district and it must be regarded as highly improbable that she could have had any extra-marital relationship which might have been responsible for her piebald offspring. Nils had one brother and one sister, but neither of them had a white forelock or white spots on the body. The brother was married and had four children who reached maturity. All had normal hair and skin.

Nils Rösland was a farmer. He married his niece Helga Monsdatter Ostereidet and had 8 children. Three of them have a white forelock, all three are married and have both children and grandchildren who have inherited the anomaly. There are no other cases of intermarriage in the family than that named above. Most of the descendants live in the country; of the families which have the anomaly two live in Bergen, the rest on Osterőy. They are farmers, craftsmen or laborers almost without exception. Aside from the piebald character they have no special peculiarities. I have not made any intelligence tests, but all seem to be endowed with well over normal intelligence. As far as I can determine there is no insanity or subnormal intelligence in the family. There are no individuals with unpigmented iris, photophobia or mystagmus. I have made no examination for myopia but there is in

**PIGMENT PATTERN ON THE LEGS**

**Figure 5**

White areas on the legs of two piebald sisters, 161.5 and 161.6. The pattern shows less clearly on untanned skin.

no case any extreme nearsightedness.

They are all slightly ashamed of the white forelock, usually clip it short and let the rest of the hair grow long so that the spot is covered. Only the children allow themselves to become sunburned and even they very little. They are shy of showing their spotted bodies on bathing beaches or other places.

It is unnecessary to give single descriptions of the pigment anomaly in each individual as this would only lead to constant repetitions. The same characteristics are present in all affected individuals, only the degree varies. In Table I all the members of the family are recorded. Those that have the anomaly are marked +, those without it ÷.

## Discussion

It is quite clear from the family tree that this is a case of simple dominant heredity. There is no instance of the anomaly being transmitted by a normal individual. According to expectation half of the offspring of the affected individuals should show the anomaly. In

this case the ratio is 41:30 if the doubtful cases are included among the normals. This is a considerable preponderance of piebald individuals. This preponderance is present in almost all the individual families. If the uncertain cases are disregarded there is an excess of abnormally pigmented individuals in 8 of the families, in two families the ratio is 1:1 and in only two families is there an excess of normals. On the assumption that the uncertain cases had normal pigmentation the proportions are: 7 families with excess of spotted individuals, 3 with excess of normals and 2 with both classes equal. The numbers are small and the deviation is apparently due to chance.

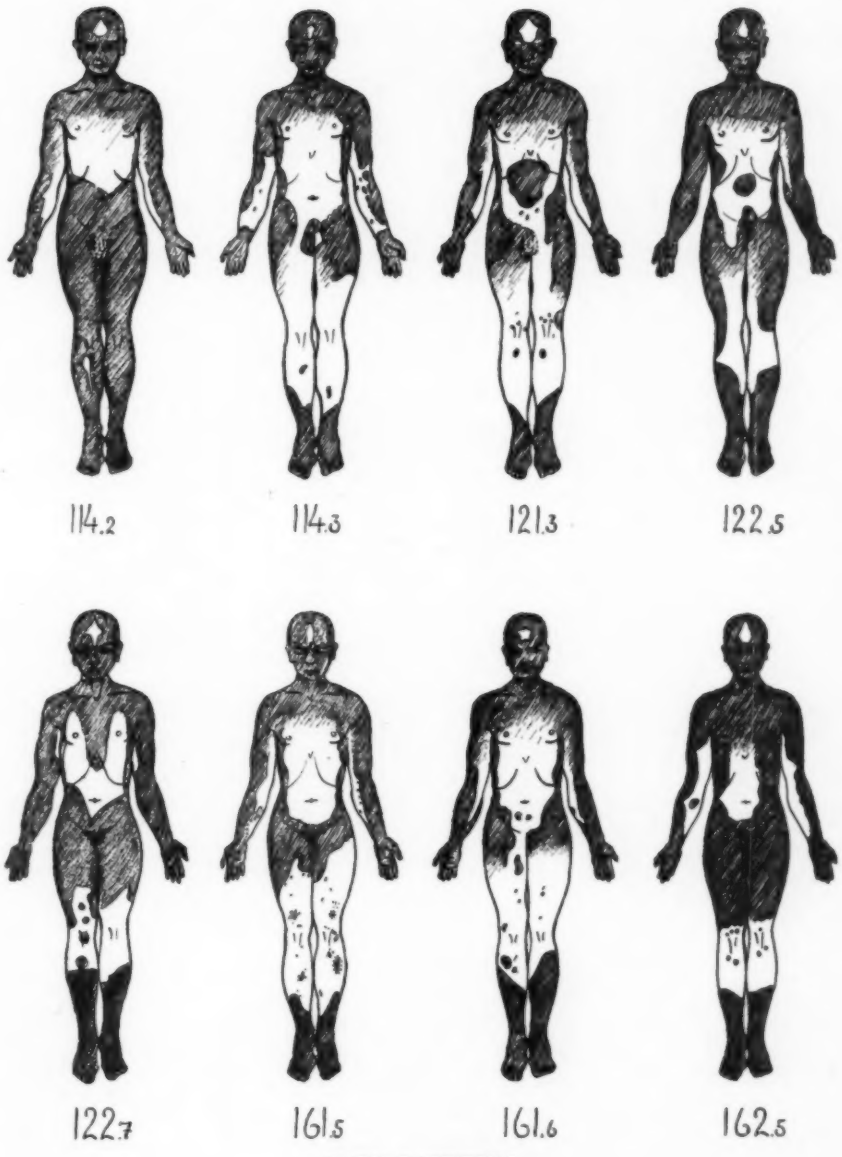
The total of men and women with the anomaly is almost equal, 21:20 but the excess of affected individuals is greater for women, 20:10 as compared to 21:15 for the men if the uncertain cases are omitted and 20:13 as compared to 21:17 if the uncertain cases are assumed to have been normal.

No marriage between two affected individuals has taken place so the gene has never been observed in homozygous

**TABLE I. Piebalding, Hair and Eye Color in the Rosland Family**

| | | | Born | Died | Hair | Eyes |
|---|---|---|---|---|---|---|
| 1 | N.R. | + | 1836 | 1894 | | |
| 1.1 | I.T. | + | 1864 | | 24 | 15 |
| 1.2 | A.G. | + | 1865 | | 24 | 15 |
| 1.3 | K.R. | ÷ | 1867 | | 26 | 15 |
| 1.4 | H.R. | ? | 1870 | 1871 | | |
| 1.5 | H.S. | ÷ | 1872 | | | |
| 1.6 | K.R. | + | 1875 | | 26 | 15 |
| 1.7 | N.R. | ÷ | 1877 | 1936 | | |
| 1.8 | K.R. | ? | 1881 | 1881 | | |
| 11.1 | B.T. | ÷ | 1890 | | 26 | 16 |
| 11.2 | N.T. | ÷ | 1891 | | | |
| 11.3 | H.T. | + | 1892 | | 7 | 8 |
| 11.4 | B.T. | + | 1895 | | 8 | 12 |
| 11.5 | O.M. | ÷ | 1898 | | 7 | 12 |
| 11.6 | A.T. | + | 1900 | | 25 | 15 |
| 11.7 | A.T. | + | 1901 | | 5 | 11 |
| 11.8 | H.T. | ? | 1903 | 1903 | | |
| 11.9 | H.T. | + | 1904 | | 26 | 14 |
| 11.10 | I.T. | ? | 1906 | 1906 | | |
| 12.1 | N.G. | + | 1897 | | 26 | 15 |
| 12.2 | A.F. | + | 1898 | | 26 | 12 |
| 12.3 | H.G. | ÷ | 1900 | | 26 | 12 |
| 12.4 | M.A. | ÷ | 1902 | | 5 | 14 |
| 16.1 | H.L. | + | 1897 | | 26 | 12 |
| 16.2 | N.R. | + | 1898 | | 26 | 15 |
| 16.3 | O.R. | ÷ | 1899 | | | |
| 16.4 | M.R. | ÷ | 1901 | | 7 | 15 |
| 16.5 | A.N. | + | 1903 | | 26 | 12 |
| 16.6 | S.R. | + | 1903 | | 26 | 14 |
| 16.7 | H.R. | ÷ | 1907 | | 26 | 12 |
| 16.8 | J.R. | + | 1910 | | 26 | 12 |
| 16.9 | A.R. | + | 1912 | 1912 | | |
| 16.10 | A.R. | + | 1914 | 1928 | | |
| 16.11 | I.R. | ÷ | 1917 | | 11 | 12 |
| 113.1 | I.T. | + | 1923 | | 3 | 12 |
| 113.2 | H.T. | + | 1925 | | 7 | 8 |
| 113.3 | L.T. | + | 1928 | | 3 | 6 |
| 113.4 | I.T. | + | 1933 | | 1 | 5 |
| 113.5 | L.T. | ÷ | 1936 | | 1 | 5 |
| 114.1 | Stillborn? | | | 1923 | | |
| 114.2 | P.T. | + | 1924 | | 26 | 15 |
| 114.3 | I.T. | + | 1926 | | 26 | 12 |
| 114.4 | I.T. | ÷ | 1928 | | 14 | 12 |
| 114.5 | O.T. | ÷ | 1931 | | 15 | 12 |
| 114.6 | M.T. | ÷ | 1933 | | 17 | 12 |
| 114.7 | R.T. | ÷ | 1936 | | 20 | 15 |
| 116.1 | J.T. | + | 1933 | | 18 | 15 |
| 121.1 | B.G. | ÷ | 1920 | | | |
| 121.2 | K.G. | ÷ | 1921 | | 5 | 12 |
| 121.3 | A.G. | + | 1924 | | 26 | 12 |
| 122.1 | M.F. | + | 1919 | 1919 | | |
| 122.2 | A.F. | + | 1920 | | 14 | 12 |
| 122.3 | A.F. | ÷ | 1922 | | 8 | 15 |
| 122.4 | B.F. | ÷ | 1923 | | 5 | 15 |
| 122.5 | J.F. | + | 1925 | | 24 | 15 |
| 122.6 | M.F. | + | 1926 | 1927 | | |
| 122.7 | M.F. | + | 1928 | | 22 | 15 |
| 122.8 | H.F. | + | 1930 | 1931 | | |
| 161.1 | S.L. | ÷ | 1920 | | 7 | 8 |
| 161.2 | A.L. | + | 1921 | | 13 | 11 |
| 161.3 | K.L. | + | 1923 | | 26 | 12 |
| 161.4 | B.L. | + | 1925 | | 8 | 13 |
| 161.5 | A.L. | + | 1927 | | 19 | 8 |
| 161.6 | I.L. | + | 1930 | | 18 | 7 |
| 161.7 | B.L. | ÷ | 1933 | | 19 | 15 |
| 162.1 | K.R. | ÷ | 1921 | | 26 | 11 |
| 162.2 | B.R. | ÷ | 1921 | | 7 | 14 |
| 162.3 | K.R. | + | 1924 | | 26 | 11 |
| 162.4 | G.R. | + | 1925 | | 26 | 15 |
| 162.5 | J.R. | + | 1932 | | 19 | 15 |
| 162.6 | A.R. | + | 1934 | | 19 | 11 |
| 165.1 | G.N. | + | 1936 | | 26 | 10 |

Hair color after Eugen Fischer, eye color after Rud. Martin.




**BODY PATTERNS**

**Figure 6**

Drawings showing the distribution of the unpigmented areas on the body. As these do not tan like the rest of the body, the white areas were most noticeable where the skin was exposed to the sun. The white spot on the forehead is found on all affected individuals, although only a few hairs may be involved.

form. Therefore it is impossible to state what effect the gene would have in a homozygote. It is quite possible that the dominant piebald gene, which causes the harmless pigment anomaly in heterozygotes, might lead to more serious consequences in homozygotes. Marriage between two piebalds is therefore inadvisable although it would be interesting to see the result.

As mentioned above, the size and extent of the white spots varies considerably but there is no evidence that stronger or milder expression of the gene is peculiar to any particular lines or families. On the contrary the phenotype varies over a wide range within the individual families. For example 114.2 has very little unpigmented skin on the body and extremities while his sister, 114.3 has at least as much as any of the others Fig. 6). Similarly 161.4 (Fig. 1) has one of the largest white forelocks I have ever seen while his sister 161.6 has only 10-20 white hairs on the forehead.

Nor is there any correlation between the size of the forelock and the extent of the unpigmented spots on the body. Again 161.6 serves as an excellent example; she lacks the white forelock almost completely but is extensively spotted on the body and limbs (Figures 5 and 6). On the other hand 121.3 shows extreme expression of both the forelock and spotting (Figure 6).

Table II shows the distribution of the various hair and eye colors.

Even though these tests are not very exact, they show that the anomaly has no connection with any particular hair or eye color.

In their extensive collected data in "A Monograph on Albinism in Man" Pearson and his co-workers[4] have also included anomalies in pigment distribution. He gives reproductions of a number of photographs, portraits and models of the same anomaly as that found in the Rősland family, but for many of the reported cases he has only hearsay evidence to go by as no personal examinations were made. Judging from the descriptions and photographs there are several cases of piebald spotting similar to that in the Rősland family, others have more extensive spotting and others much less spotting, but the main characteristics are recurrent in all cases: white forelock, white areas on the abdomen, the arms and around the legs, the back is usually completely normal, the median line always normal. Cockayne in his book on inherited skin abnormalities[1] has collected all the published reports of

**TABLE II. Distribution of Hair and Eye Color**

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hair | 26 | 25 | 24 | 22 | 20 | 19 | 18 | 17 | 15 | 14 | 13 | 11 | 8 | 7 | 5 | 3 | 1 |
| Spotted .... | 16 | 1 | 3 | 1 | 0 | 3 | 2 | 0 | 0 | 1 | 1 | 0 | 2 | 2 | 1 | 2 | 1 |
| Normal .... | 5 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 4 | 3 | 0 | 1 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Eye color | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 8 | 7 | 6 | 5 |
| Spotted .... | 0 | 12 | 2 | 1 | 10 | 4 | 1 | 3 | 1 | 1 | 1 |
| Normal .... | 1 | 6 | 2 | 0 | 8 | 1 | 0 | 1 | 0 | 0 | 1 |

**TABLE III. Summary of Piebalds with Frontal Blaze in Man**

| Author | Gen. | No. | ● | ○ | ♂ | ♀ | ● | ♂ | ♀ | ○ | ? | Nationality |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cockayne | 6 | 20 | 18 | 20 | 11 | 9 | | 9 | 5 | 6 | | English |
| Harman | 6 | 24 | 23 | 15 | 9 | 15 | | 7 | 8 | | | English |
| Le Vallois | 3 | 5 | | | 4 | 1 | | | | | | European |
| Newton Miller | 6 | 45 | 45 | 51 | 25 | 20 | | 23 | 28 | | | English origin |
| Pardo-Castello | 4 | 11 | 10 | 5 | 6 | 5 | | 5 | | | | Spanish |
| Jones | 4 | 11 | 9 | 8 | 3 | 8 | | 5 | 3 | | 2 | English |
| Emslie | 3 | 3+ | | | 2 | 1 | ? | | | | | Negro |
| Neveu Lemaire | 2 | 4 | 3 | | 4 | | | | | | | Negro |
| Pearson, Castle and Simpson | 3 | 18 | 17 | 9 | 7 | 9 | 2 | 4 | 5 | | | Negro |
| Stannus | 5 | 9 | 8 | 10 | 5 | 4 | | 2 | 2 | 6 | | Negro |
| | | 150 | 133 | 118 | 76 | 72 | 2+ | 55 | 51 | 12 | 2 | |
| Sundför | 4 | 42 | 41 | 25 | 22 | 20 | | 15 | 10 | | 5 | Norwegian |

piebalds with frontal blaze, the type to which the present case belongs. Most of these are described in detail by Pearson.[4] There are not many instances of the piebald anomaly, in all 13 isolated individuals and 10 families. They are distributed over widely separated geographic areas and among various races. Most of the isolated cases have been negroes. The nationalities of the various families appear in Table III after Cockayne. The Rősland family is added below.

Cockayne reports two additional families in which the inheritance is not quite clear and which he therefore has not included in the table.

In all of the families reported the anomaly is inherited as a simple dominant factor.

In a recent paper Fitch[2] describes a dominant white forelock which "is often accompanied with a few white spots in the skin on various parts of the body". The anomaly occurred in 12 individuals covering 5 generations. From the brief description it is difficult to decide whether this case belongs to the type here dealt with or to the group which Cockayne has separated out under the term "White Forelock Spotting (Dominant type)."

It must be regarded as almost impossible that this hereditary character can have come into the Rősland family through any illegitimate relationship. It must therefore be a spontaneous mutation. Several of the previously published cases seem to be examples of similar spontaneous mutation. Cockayne writes: "Their great rarity, the widely separated parts of the world in which they have been found, and the fact that they have occurred in such different races would be proof that the piebald pattern has appeared on several different occasions as a new mutation, even if we had no evidence that some at least were born of normal parents."

Pearson includes several forms of lack of pigment, among them the one here discussed, together in a group which he calls "Partial albinism". He believes that there may possibly be some connection between all these anomalies and the recessive true albinism. Cockayne maintains that the piebald pattern is quite distinct from true albinism: "Albinism of all grades is due to an inability to form pigment at all or to form enough pigment, but the piebald condition is a matter of the distribution of pigment, and the cause is totally different in the two cases." Nor is there anything in the Rősland family which suggests that the piebald anomaly has the least connection with true albinism.

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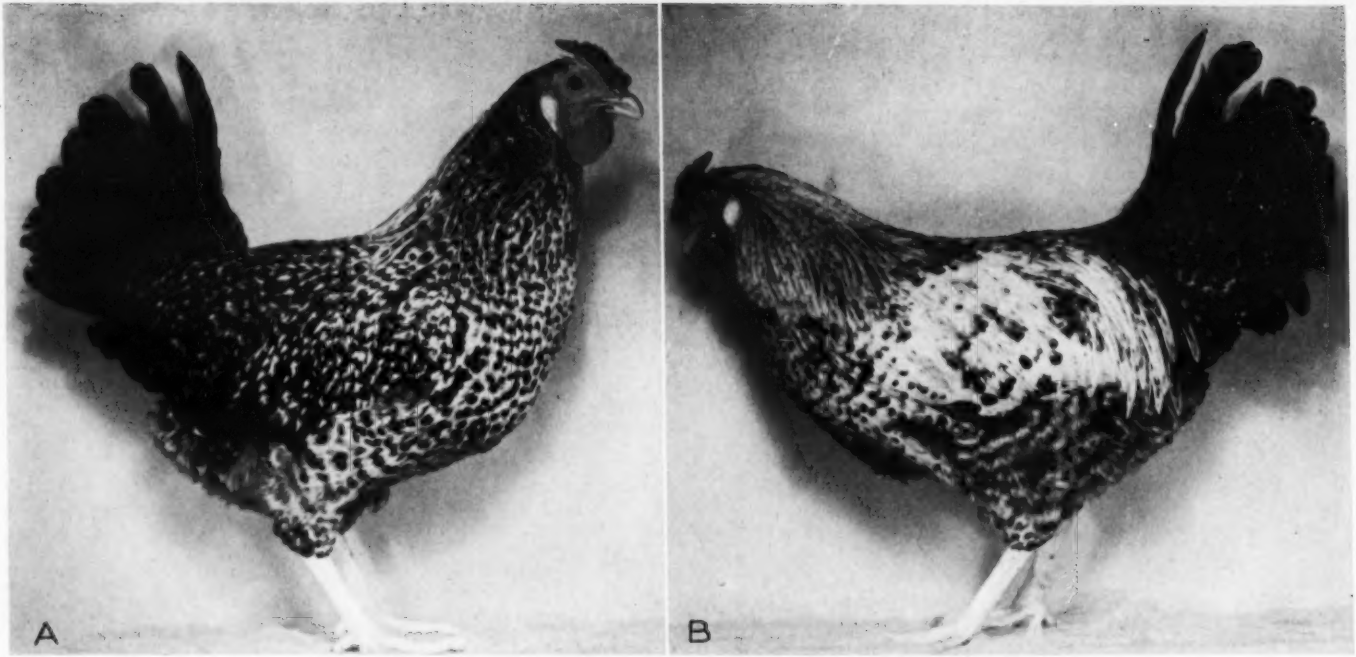
## Migration and the Negro Birth Rate

The migration of Negroes from the rural south to urban centers of the north has been accompanied by marked reductions in Negro fertility. Within the rural populations the fertility of Negroes exceeds that of white. In northern cities, however, Negro marriages are frequently less fertile than white marriages. Studies have indicated that the proportion of childless families among Negro marriages in northern urban communities may in some cases be as much as twice as high as that among whites in the same area. We have yet to learn the reason for this disparity in extent of childlessness.—Dr. Clyde V. Kiser, *in Birth Control Review.*




**TWO SIDES OF THE ARTIFICIAL "GYNANDROMORPH"**

**Figure 7**

Right and left sides of a pseudogynandromorph. *B*—normal plumage of $F_1$ male from cross, Barred Plymouth Rock male × Silver Spangled Hamburg female. *A*—same fowl showing plumage grown under influence of daily injections of 450 rat units of Progynon-B.

# A PSEUDOGYNANDROMORPH IN THE FOWL

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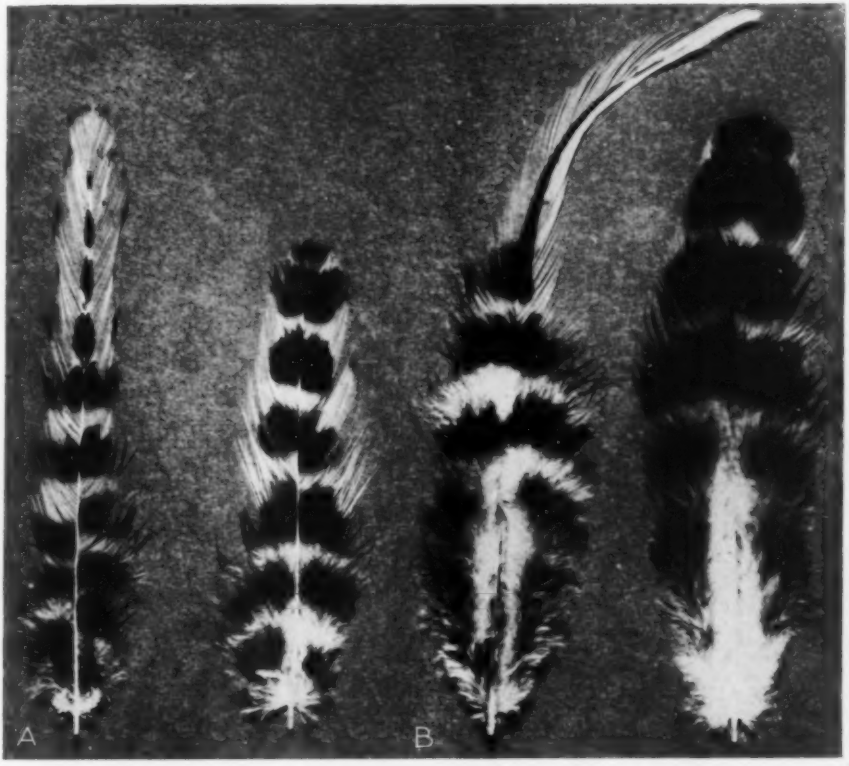


**"MALE" AND "FEMALE" FEATHERS FROM THE SAME BIRD**

**Figure 8**

Representative pairs of feathers from the left (male) and right (female) sides of the fowl in Figure 7. The feathers were obtained from (*A*) hackle and (*B*) saddle. The left feather of each pair is of normal male type. The sex hormone has changed both the pigment distribution and the shape of the feathers grown under its influence.

THE pseudogynandromorph illustrated in Figure 7 was produced to demonstrate in a striking manner the effect of female sex hormone upon both the color and structure of the fowl's plumage. The facts making possible the extreme differences in appearance between the right and left sides of this bird are as follows:

1. Developing feathers exposed to the

influence of co-existent male and female sex hormones have a structure like those of normal females. Such modification can be induced either by plucking feathers from a normal male and injecting extracts of female sex hormone during the growth of new feathers, or by plucking feathers from a male following successful implantation of ovarian tissue, as has been done by several investigators. In feathers of the sex-dimorphic regions (neck, wing bow and cushion) the area free from barbules is reduced in females to a narrow fringe at the periphery. In males the area free from barbules is much wider, thus accentuating the lanceolate appearance of feathers on the sex-dimorphic regions.

2. In males heterozygous for the incompletely dominant gene for spangling, *Sp*, the gene for extension of black, *E*, and the sex-linked gene for barring, *B*, the sex-dimorphic regions carry much less black pigment than do the corresponding regions of females of similar genotype. Figure *7A* and *7B* illustrate the fact that in such a genotype the character, extension of black, is epistatic to spangling only in the presence of the female sex hormone.[1]

3. Feathers regenerate in about six weeks when a large area of the body is plucked. Any modification of plumage structure or color induced by treatment during the regeneration of feathers remains a part of the bird until lost in a subsequent molt. This makes possible the use of such demonstration material for several months following its preparation.

To illustrate within a single bird the relationship between the female sex hormone and the color and structure of plumage, two pseudogynandromorphs were planned. Mature male $F_1$ progeny of a Barred Plymouth Rock male and a Silver Spangled Hamburg female were selected and all feathers excepting remiges were plucked from the right side of their bodies. At the time of plucking these males were uniformly lighter than their full sisters and showed traces of spangling (Figure *7B*) as was observed by Taylor[1] in males heterozygous for spangling.

These cockerels were given injections of Progynon B (benzoic acid ester of dihydro-follicular hormone in a solution of oil)* twice daily as follows:

| | rat units daily |
|---|---|
| 1-39 days (excepting Sundays) | 450 |
| 46-54 days | 450 |
| 55-60 days | 1000 |

The new feathers, grown under the influence of female sex hormone, were of female structure and barred throughout, whereas the hackle, saddle and wing feathers had been irregularly white and spangled prior to plucking (Figure *7B*). The resulting pseudogynandromorphs, one of which is illustrated in Figure *7*, bear normal male plumage on the left (Figure *7B*), thus effectively illustrating the influence of female sex hormone upon both the color and structure of feathers which have the same genetic constitution.

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## Mutation with a Vengeance

Bier, August. *Neue Gesichtspunkte in der Vererbung*. Pp. 70, price RM 3.60. Berlin, Julius Springer, 1938.

Seed of the yellow lupine (*Lupinus luteus*) which had been kept for 68 years was planted with 100% germination. Among the progeny were some plants indistinguishable from the blue lupine (*L. angustifolius*) and others identical with the perennial *L. polyphyllus;* both of these types later bred true. The author calls this transmutation. — P. POPENOE.

*Contributed by the Schering Corporation, Bloomfield, New Jersey.

# A CHLOROPHYLL DEFICIENT PIMIENTO*

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**ONE IN TWENTY THOUSAND**

**Figure 9**

*A*—A chlorophyll-deficient pimiento plant, of which one-half is entirely green. *B*—The same plant growing in the field of normal plants in which it was found. This was the only plant so affected in a field of some 20,000 plants.

CHLOROPHYLL deficiencies are not uncommon in some plant genera while in others they have not been reported. This does not necessarily mean, however, that one genus naturally produces many such anomalies and others only a very few or none at all. The seemingly most logical explanation is that, scarcely without an exception, those genera in which the deficiencies have been most common are the ones the geneticists and plant breeders have worked on for a long period, thus allowing them to observe many populations. In the more or less neglected genera, from the standpoint of breeding work, reports of chlorophyll deficiencies are relatively scarce.

The literature reveals no occurrence of a chlorophyll deficiency in the genus *Capsicum* with the possible exception of an abnormality in the pimiento which Higgins[1] considered to be due to an infectious mosaic disease.

Early in 1931 the writer started work on some problems related to pepper production. During the course of this seven-year period, many thousands of plants have been examined growing under both greenhouse and field conditions in Oklahoma, New York, and Georgia and at no time has a chlorophyll-deficient plant been noted until recently. However, among approximately 20,000 selected pimiento plants grown for experimental purposes during 1938 at and near Experiment, Georgia, a field of which is shown in Figure 9, a plant was observed that exhibited this character.

The plant was first noticed in the field

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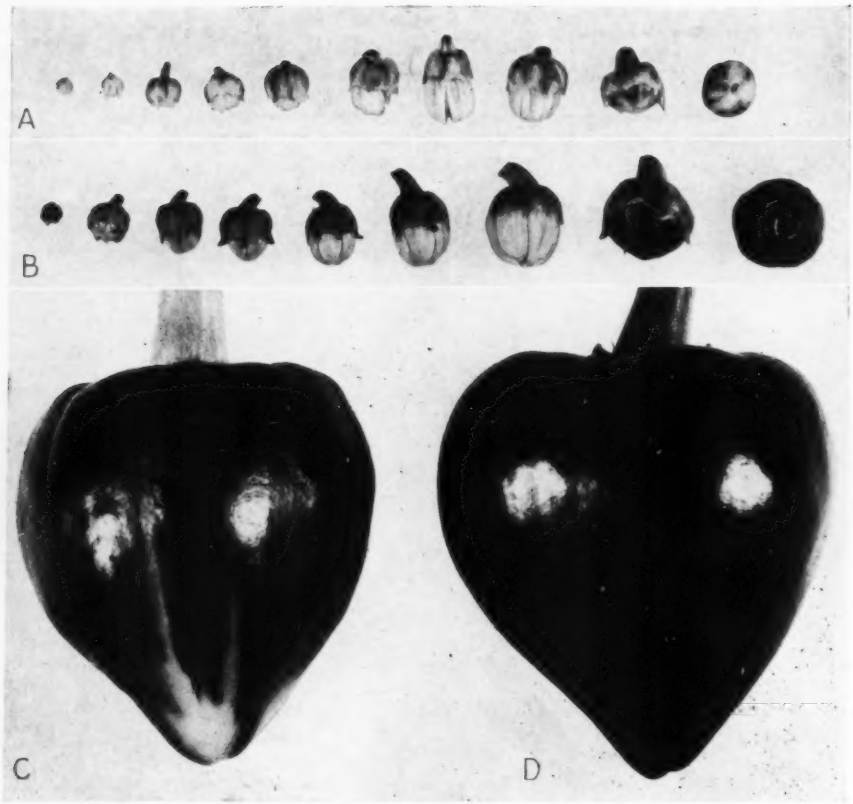



**ALBINOTIC AND NORMAL FRUIT FROM THE SAME PLANT**

**Figure 10**

Fruit buds of various ages showing (*A*) white areas on the pedicel, calyx and ovary, contrasted with the normal buds (*B*) from the other half of the plant. Below are shown a partially mature fruit with white chlorophyll-deficient areas near the apex and in which the pedicel lacks chlorophyll (*C*), as compared with a normal half-grown fruit from the green portion of same affected plant (*D*).

on June 16 after which time it was observed closely to note the variations and peculiarities that developed. As can be seen in Figure 9, only one-half of the plant exhibited the chlorophyll-deficient character, the other half being normal in every respect. The deficiency was not only exhibited in the leaves of the plant but in the young buds, flowers, and fruits as well.

The extent of the white areas on leaves varied in different leaves from as much as 95 per cent in some to as little as five per cent. The young leaves, including the petiole, were usually highly deficient in chlorophyll and many abscissed before reaching as much as 1.5 centimeters in width due probably to their low photosynthetic activity. In general the abnormal leaves were somewhat smaller than those of normal plants. Much of the white area, especially that around the leaf border, was very brittle and soon became dry and fell, thus causing the leaves to become curled or rolled.

Since Higgins[1] has classed a somewhat similar case of chlorophyll deficiency as a mottling or calico type of mosaic

disease in the pimiento, several injections of sap from deficient leaves were made with a hypodermic needle into normal green leaves of various ages on June 21 in an effort to determine whether or not the condition as reported here was due to the same cause. Some of the treated leaves abscissed soon after the injections were made, but of those that remained intact not one exhibited any signs of a reproduction of the chlorophyll-deficient condition by September 30th.

All buds and flowers on the variegated plant portion showed some chlorophyll-deficient tissue although it was quite variable both in the time and degree of expression. The white areas appeared in various patterns on the calyx and young ovaries (Figure 10*A, B*).

As was true of the leaves, many of the highly chlorophyll-deficient buds dropped at an early stage of development. Those remaining were smaller than normal, due probably to a lack of available synthesized plant food.

### Fruits

The chlorophyll-deficient areas on the young ovaries usually started at the apex and radiated out in small bands toward the base. With the growth of the fruit there was a corresponding increase in size of the white areas. No complete albinos were ever produced. None of the fruits remained on the plant long enough to become mature. One did reach approximately the half grown state but soon afterwards abcissed (Figure 10*C*).

Although about two-thirds of the area of this fruit was green, the pedicel contained practically no chlorophyll. The seeds of this fruit were not sufficiently mature to germinate, which brought the investigation to a close.

### Summary

A chlorophyll-deficient pimiento has been described in which the leaves, buds, flowers and fruits were involved. In none of the plant parts were the patterns of the chlorophyll-deficient areas constant as to shape or time of expression. Due to early abscission of the fruits no viable seed could be obtained to make a study of the mode of inheritance of the character involved.

Under the conditions of the experiment the chlorophyll deficiency as reported here does not seem to be the same as a similar one reported earlier in the pimiento by Higgins.

### Literature Cited

1. Higgins, B. B. Important diseases of pepper in Georgia. *Georgia Experiment Station Bulletin* 186. 1934.

## Fertility in Cross-bred Mice

To the Editor:

In an attempt to recover new recessive genes by inbreeding fanciers' material, a few observations about the fecundity of mice were made which are sufficiently unusual to be put on record, although no full analysis has been attempted or had, indeed, been intended.

Adult mice of unknown origin were purchased from a mouse fancier and mated up in pairs. The original material was highly heterogeneous, most matings showing segregation for one or more genes already in the $F_1$. Eight to ten matings of $F_1$ animals were set up in each case. One such group showed a very remarkable fertility, as shown by the figures in Table I.

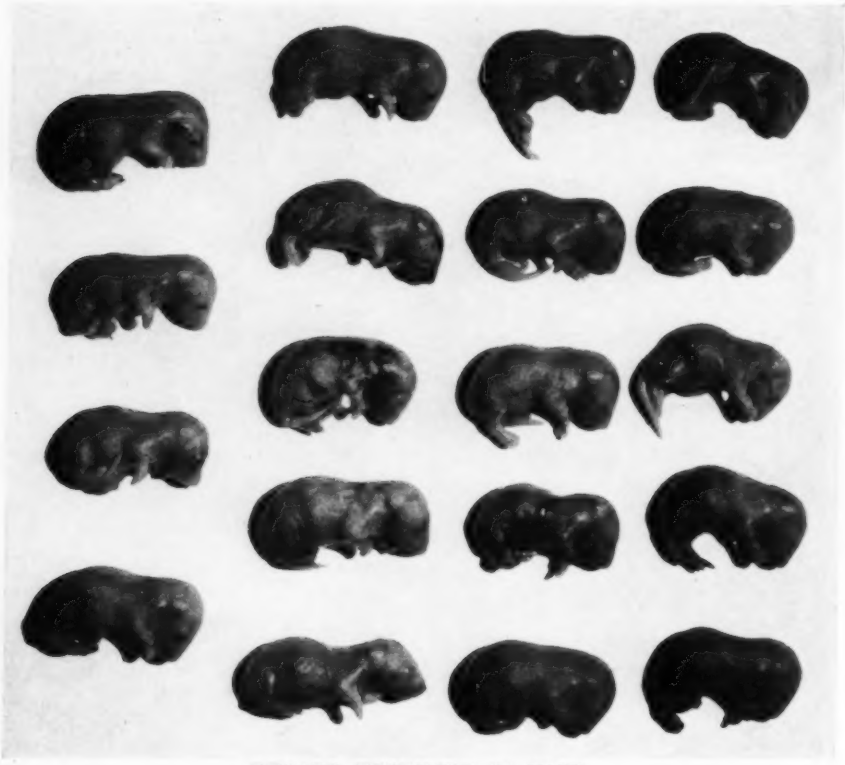
**TABLE I. Litter Size in Fancy Mouse Crosses**

| Pair | Litter 1 | 2 | 3 |
|---|---|---|---|
| A | 13 | 12 | 11 |
| B | 10 | 12 | 17 |
| C | 12 | 11 | |
| D | 10 | 11 | |
| E | 8 | 11 | 9 |
| F | 7 | 11 | |
| G | 14 | 13 | |
| H | 13 | 10 | |
| I | 13 | 11 | |

The average litter size was therefore as high as $11.38 \pm 0.53$. Pair B produced a litter of 17 young, all remarkably well developed, of which 11 were reared. So far as I am aware, this is considerably beyond the known range of litter size. In a material of well over 3,000 litters from various more or less inbred stocks, I have observed litters of 14 young but three

**TABLE II. Weights of Nineteen Embryos—Fourth Litter of Pair *B***

| | Right horn | | Left horn | |
|---|---|---|---|---|
| | 1.31 | 1.45 | 1.41 | 1.65 |
| | 1.39 | 1.53 | 1.43 | 1.66 |
| | 1.43 | 1.58 | 1.51 | 1.77 |
| | 1.43 | 1.65 | 1.51 | 1.81 |
| | 1.45 | 1.69 | 1.59 | |
| Average | 1.49 | | 1.59 | |



**RECORD FERTILITY IN MICE**

**Figure 11**

A litter of 19 mice, natural size. The embryos shown in the two right rows were in the right horn of the uterus, the rest in the left horn.

times. Two litters of 15 were recently obtained from a female which belonged to a parallel series of $F_1$ matings from fanciers' mice, but no larger litters have come to my notice.

When the third litter of pair B was discarded at the age of 23 days, the mother exhibited such prodigious dimensions that it was decided to count the embryos in utero so as to avoid early depletion by the mother. The result is shown in the accompanying photograph. There were as many as 19 embryos, obviously practically full-term. Ten of them were in the right horn of the uterus and nine in the left. All the animals were well developed, as shown by their weights (Table II).

The average weight of all the young is 1.54 g. The average for the more crowded right horn is slightly lower than that for the left horn, but the difference is hardly significant. The weights of the young compare very favourably with average birth weights of smaller litters. A litter of ten, from a different vigorous stock, which I weighed recently immediately after birth averaged 1.34 g. with a range from 1.22 to 1.43 g. This is in good agreement with numerous other new-born litters that I have weighed during the last few years. The litter of nineteen is therefore remarkable not only for the number of embryos, but also for their size (Figure 11).

The unusual fertility of these fanciers' mice may be attributed to "hybrid vigour." As different sub-strains seem to vary considerably as regards both litter size and quickness of succession of litters, such material, when used in conjunction with a standard Pure Line, may prove of value for a genetical analysis of fertility.

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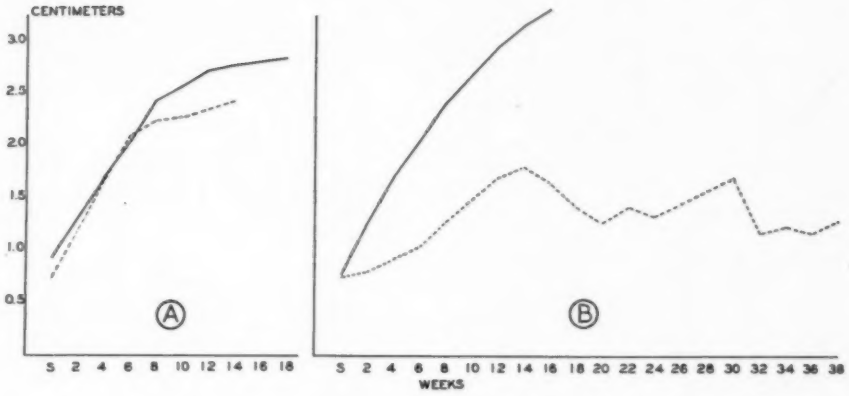
# A DIFFERENTIAL EFFECT OF METHYL SALICYLATE ON THE GROWTH OF SPONTANEOUS TUMORS IN TWO STRAINS OF INBRED MICE

LEONELL C. STRONG*




**DIFFERENT EFFECTS ON TWO STRAINS**

**Figure 12**

*A*—This chart shows the average growth rate of spontaneous tumors of the mammary gland in female mice of the Strong *A* strain (a) 120 controls (solid line) and (b) 55 mice receiving methyl salicylate in their diet (dash line). There is little or no difference between the two curves. *B*—This chart shows the average growth rate of spontaneous tumors of the mammary gland in female mice of the Strong *CBA* strain (a) 18 control mice (solid line) and (b) 17 mice receiving methyl salicylate in their diets (dash line). There is an inhibitory action of the chemical on the growth-rate of the tumors. There is also an indication of increased survival time of those mice receiving methyl salicylate, as indicated by the lengthened growth-rate curve.

DATA have been obtained which indicated that the addition of small amounts of redistilled synthetic methyl salicylate had no detectable influence on the growth rate of spontaneous tumors of the mammary gland in female mice of the Strong *A* strain.[1] Recently spontaneous-tumor-bearing mice of other inbred strains have been tested with this same agent. The present paper presents data on the effect of methyl salicylate on the growth rate of spontaneous tumors in female mice of the Strong *CBA* strain.

Contrary to what was expected from the observations on mice of the *A* strain, there appeared to be a significant effect of this chemical on the growth of tumors in mice of the *CBA* strain. The tumors not only grew slower but the tumor-bearing animals actually lived longer. The growth rate of tumors under treat-

*From the Department of Anatomy, Yale University, School of Medicine, New Haven, Conn. This experiment has been made possible by grants from the International Cancer Research Foundation, the Anna Fuller Fund, and the Jane Coffin Childs Memorial Fund for Medical Research.

ment wtih methyl salicylate in *A* mice is compared to that of the growth rate for the controls in Figure 12*A*. Comparable data for mice of the *CBA* strain are given in Figure 12*B*.

In both series, the method followed was to vary the amount of methyl salicylate given to each mouse separately from day to day, the idea being carried out to give the maximum effective dose per unit of time per individual mouse without in any way interfering with the health and body weight of the individual. It is felt that this individual use of dosage in relation to the physical condition of the mouse is a very important consideration. The dosage used varied from time to time from one drop of the oil and three grams of food to two drops of the methyl salicylate and one gram of the oatmeal mixture.

### General Discussion

Female mice of the Strong *CBA* strain are more tolerant to methyl salicylate than are mice of the Strong *A* strain. For example, *CBA* mice will continue to keep up their original body weights on doses of methyl salicylate that *A* mice will not eat. The difference obtained on the effect of methyl salicylate on the growth rate of spontaneous tumors may thus be due to a quantitative difference in dosage. The average body size of the mice of the two strains, however, is approximately the same.

The laboratory conditions, food and all environmental conditions were the same for both strains of mice. The spontaneous tumors were histologically very similar to each other.* The greater tolerance response of *CBA* mice to methyl salicylate may be due then to their intrinsic genetic constitutions.

In the testing of standard amounts of chemicals on the growth rate of spontaneous tumors in mice, emphasis should be placed, not only on individual but possibly on genetic differences also. It is only when this is done, that comparable results may be expected from investigators working in different laboratories.

### Summary

Methyl salicylate administered to mice in their diets has a pronounced effect on the growth rate of spontaneous tumors in female mice of the Strong *CBA* strain; it has no inhibitory action on the growth rate of spontaneous tumors in female mice of the Strong *A* strain. The investigation emphasizes the possibility that spontaneous tumors in mice, at least, may be controlled eventually by chemotherapy.

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## Editor Lays "Robbin" Eggs

To the Editor:

On page 2, Vol. 30, No. 1 of the Journal of Heredity, I find a brief note entitled "A Pair of Albino Robbins," which I read with some interest, particularly on account of the unique spelling of the last word of the title, both in the title and in the note following. I am wondering whether or not the albinism reported may not, by some chance, be related to the Scottish or dialectic English ancestry of the "robbins." Possibly some light on this phenomenon might be furnished by Webster.

Yours sincerely,
F. W. S. Scudder.

Those "robbins" are a distressing mystery. We started off orthographically *right*, and by some strange transmutation—possibly a translocation of the "R" chromosome, we ended up *wrong*—with what comfort we can gain from being *consistently* wrong eight times in a row. The proof was read by five people who ought to know how to spell so simple a word as that. The editor reports he can spell chromosome, anaphylaxis, amphidiploids, and in this issue, pseudogynandromorph. He would like to talk in exotic polysyllables for a while, until everybody forgets those robins.—Ed.

*The average growth rate of tumors in control *A* mice was the same as that obtained in control *CBA* mice.

# THE INHERITANCE OF BRACHYMETAPODY*

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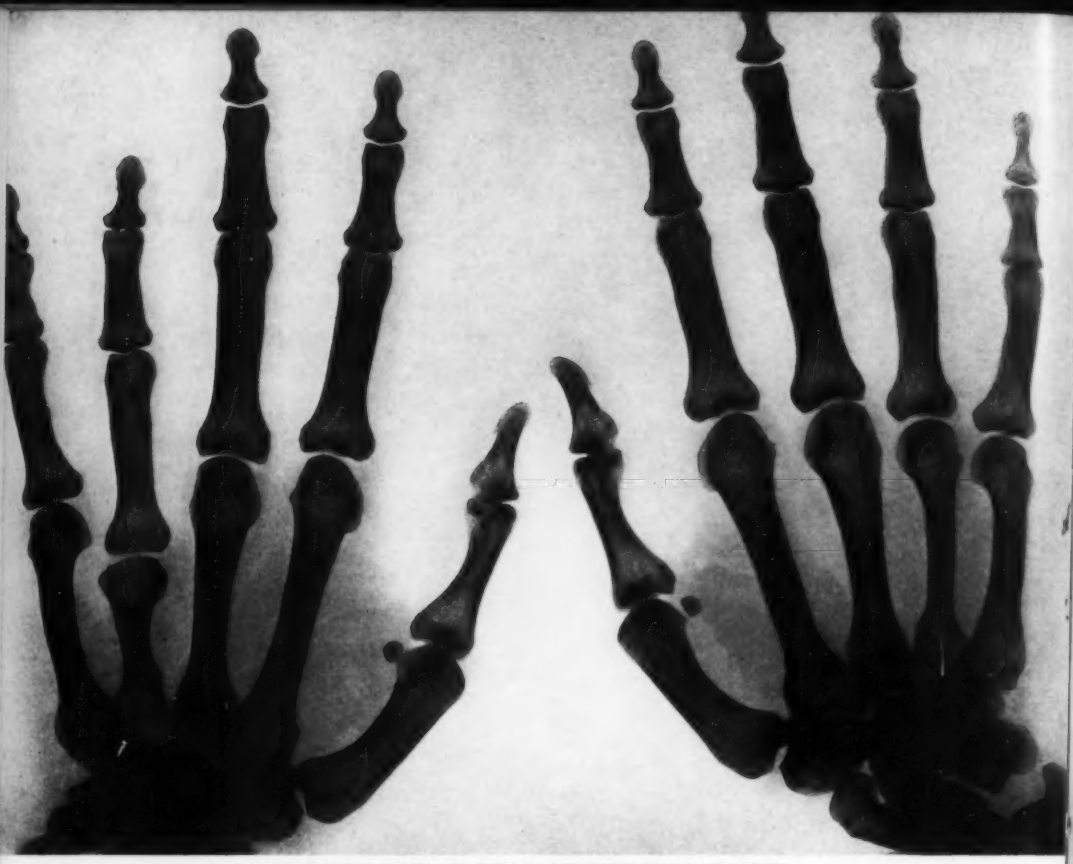
BRACHYMETAPODY is a condition in which certain digits of the hand or foot appear abnormally short. While it may seem that the phalanges are the cause of this defect, X-rays have shown that it is due to the relative shortness of either the metacarpals or metatarsals. Brachymetapody, as far as the author can determine, is relatively rare. A rather careful survey of the medical literature concerning anomalies of this type reveals less than a half dozen titles in the English language, and not many more in the foreign literature as could be determined from the various medical indices. Some cases may have been overlooked because they were under such irritating titles as "An Unusual Case," or "A Rare Maldevelopment," which give no idea of the nature of the deformity or what tissues were involved.

Of the medical reports in English of metacarpal or metatarsal hypoplasia very few suggest even the possibility of its having a hereditary basis. In fact, most cases are of an isolated nature without knowledge about other members of the same family. Kanavel,[7] in a general discussion of malformations of the hands, offers the opinion that many of the congenital anomalies have their origin in the germ plasm. Other reports by Hanflig,[5] Day,[3] and Beadnell[1] on brachymetapody make no mention of its possible hereditary nature. Likewise most of the foreign medical papers on brachymetapody do not mention any hereditary factor, though there are typical cases reported by Markalous,[9] Skirving,[12] Castay,[2] and Hissard.[6] Miskolczy[10] reports a case for which there was not only a hereditary basis for brachymetapody but also a possibility of its correlation with mental defect. In another paper Miskolczy[11] describes a case in which he traces the inheritance of brachymetapody through several generations and concludes from his data that it is a dominant trait.

Thus it will be seen that comparatively little is known about the exact way in which brachymetapody is inherited even though it may be conceded that there is some hereditary basis for the peculiarity. Two cases with different genetical explanations have appeared in the JOURNAL OF HEREDITY. Gillette[4] describes a case in which the fourth digit of both hands showed the defect in all affected individuals. There was, however, some variation in the expression of this trait; in one individual the third digit was also short, and in another the fifth digit. All toes were normal, as far as could be learned, except in one individual the fourth toe on the left foot was noticeably short. Hereditary skeletal anomalies not infrequently exhibit considerable variability. Stiles and Weber[13] report that similar variations occur in pedigrees of symphalangism, not only between individuals of different families but also between individuals of one particular family. Gillette considers brachymetapody to be Mendelian dominant. His chart of the inheritance of this trait makes possible the interpretation that it is dominant because all of those showing brachymetapody are presumably heterozygous for this character. However, he assumes that the gene for this hereditary

*It is a pleasure to acknowledge the assistance of Doctors A. W. Erskine and J. V. Prouty who prepared the X-ray film, of Doctor Edward H. Files and Althea A. Daleske for their cooperation in this study.



**A SHORT METACARPAL OF THE RING FINGER**

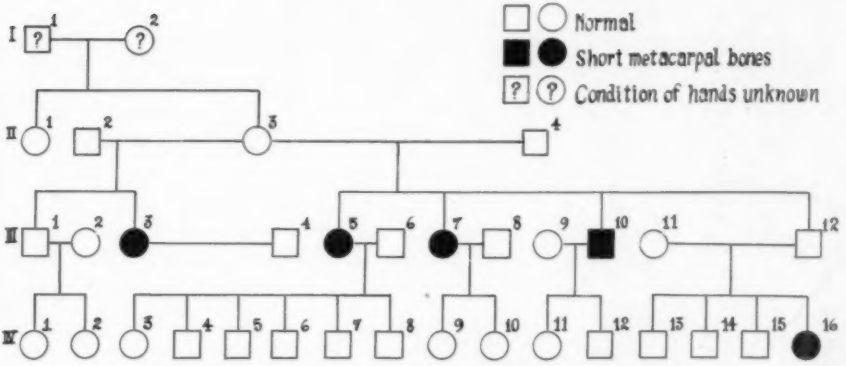
**Figure 13**

The fourth metacarpal bone in the left hand is only about two-thirds as long as the fourth metacarpal of the right hand.

defect occurred in individuals of the first and second generation who did not exhibit the abnormality. In other words, short metacarpals may show in a heterozygote, or they may be missing. This would mean that the gene is not regularly dominant. This type of inheritance has usually been defined as irregular dominance.

Koenner[8] reports a family in which only one member shows brachymetapody, a man in whom only the fourth metacarpal of the left hand was shorter than the others. In her genetical analysis of this study she states that if heredity is involved, the gene is recessive because no immediate members of the family show the peculiarity. Inasmuch as there is only one individual affected in the three generations shown in her pedigree chart, it would seem as though this could just as well be interpreted as a mutation from the normal; or, the absence of the trait in the first and second generations could be interpreted as another case of irregular dominance. Certainly there is little to justify the conclusion of Koenner that if hereditary, this character must be due to a recessive gene because no immediate members of the family show the defect.

Since in man it is not feasible to discover the exact mode of inheritance of characters such as brachymetapody by test matings, pedigrees must always remain the basis of the study of human heredity. It is therefore essential that all pedigrees which will contribute to a better knowledge of the genetics of man be reported. It should always be borne in




**INHERITANCE OF SHORT METACARPAL BONES**

**Figure 14**

A pedigree chart showing the inheritance of short metacarpals. The woman (II-3), fortunately for purposes of genetical analysis, married twice and while she fails to manifest the character herself, she must have been a carrier of the gene for this peculiarity. The appearance of this trait in the third and fourth generations by individuals presumably heterozygous for short metacarpals indicates irregular dominance as the mode of inheritance.

mind that in the study of a skeletal anomaly, as Morgan has pointed out, we are also studying the inheritance of the normal character. Considered in this light the importance of the inheritance of morbid conditions is readily apparent.

Therefore it seems worth while to report another family history of brachymetapody which offers what is believed to be a better opportunity for genetical analysis and consequently a more complete understanding of how metacarpals are inherited than those cited above. The X-ray photograph (Figure 13) shows very well the characteristic condition of brachymetapody. The affected metacarpal from birth has been only about two-thirds as long as the corresponding one in the normal hand. This X-ray picture is of the hands of a young woman (IV-16, Figure 14). It will be noted that only the fourth metacarpal of the left hand is affected. This is also true of the brachymetapodic young woman (III-3) of this pedigree. The other brachymetapodic members of the family III-5, III-7, and III-10 possess short fourth metacarpals in both hands. The brachymetapodic hand of IV-16 is not as noticeable a defect as one would suppose from the X-ray picture (Figure 13). In fact, the doctor who did the X-ray work did not observe the anomalous character of this hand until he read the X-ray plate. However, under close examination the fourth digit is seen to be more nearly the length of the fifth rather than approximately the length of the third as is usual. The phalanges are normal in number and structure, but they articulate with a short metacarpal. There appears to be no metacarpophalangeal joint, but it is palpable, and may even be seen when the hand is relaxed. A conscious effort must be made to hold the fourth digit of the left hand up when the hand is relaxed or it droops below the level of the other digits. The abnormality does not cause pain or constitute an appreciable physical handicap; for the most part, the movements of the hand seem quite normal. Bernice (IV-16) works in the stock room of a large department store where if brachymetapody constituted a serious functional defect it would be an occupational handicap, which does not seem to be true.

In so far as could be learned no member of this family shows any indication of short metatarsals; the toes of the affected individuals appear normal in length.

As discussed above, Gillette and Miskolczy consider brachymetapody as a Mendelian dominant character whereas Koenner states that if there is a hereditary basis for this peculiarity the gene must be recessive in nature in the family she studied. From the standpoint of genetical analysis it is especially fortunate that in this pedigree (Figure 14) one woman (II-3) married twice, and while she fails to manifest the character one can assume with good reason that she was a carrier of the gene. For if she were not heterozygous for the abnormality, it would be necessary to postulate that both husbands (II-2 and II-4) were, which would not be expected in such an unusual trait. Or there is still the possibility that II-3 and her first husband (II-4) and her second husband (II-2) were all heterozygous. However, this seems too highly improbable to merit serious consideration. Of course one could contend that the trait arose in the third generation, but it is highly improbable that four mutations for a trait of such great infrequency should occur in one generation of a given family.

If then the writer's first assumption, that II-3 is heterozygous, appears valid, we can proceed to further analysis. It is obvious that brachymetapody cannot be due to a simple dominant gene since it appeared in the offspring (III-3, III-5, III-7, III-10) without appearing in either parent. And further when one parent is brachymetapodic, the other normal, brachymetapodic children should make up at least half, and probably more on the average of the offspring. This expectation is not met; from four such matings there are ten normal offspring and none showing brachymetapody.

Likewise, it could not be the result of a recessive factor, though the tendency to skip generations in both the pedigrees of this study and Gillette's might suggest that. If recessive, it would necessitate the assumption that II-3 and both her husbands II-2 and II-4 were heterozygous recessive for the character, and the same assumption would also have to be made for the wife (III-11) of III-12. It is extremely improbable that so rare a peculiarity could be hidden as a recessive in several genetically unrelated individuals of a single pedigree. Also, if it were a simple recessive, then children in the third generation who presumably are heterozygous would not show the defect.

This character is not confined to one sex; therefore, it is not due to a sex-limited factor. More females are affected than males, but there is no good reason for considering it a sex-influenced trait. It could not be due to a sex-linked recessive for presumably heterozygous females exhibit the malformation. Neither could it be due to a typical sex-linked dominant, since if it were, the father (III-12) should be defective as well as his daughter (IV-16). This, however, does not rule out the possibility of an irregular sex-linked dominance, but the numbers involved are too small to have any statistical significance.

Taking all the evidence into consideration, the character does not fulfill the requirements for complete dominance (must occur in every generation, showing up on the average in half of the offspring); nor does it meet the criterion for recessiveness (must be homozygous when it appears, as evidenced by the result of mating two individuals both of whom possess the gene). It does not show any good evidence of being recessively sex-linked, sex-limited or sex-influenced. It is possible that it is due to irregular dominance,—with or without sex-linkage. The fact that the defect appears unilaterally indicates that there is a narrow balance between the expression or the suppression of the character. Such an assumption would explain the fact that some heterozygous individuals are affected and others not. Therefore, the most logical conclusion to be drawn from the data would be that brachymetapody behaves as an irregular dominant.

## Summary

1. Brachymetapody is defined as the occurrence of short fingers or toes due to a shortness of the metacarpals or metatarsals.

2. Brachymetapody is variable in its physical expression even between differ-

ent individuals of the same family. It may occur symmetrically or in only one hand, or in both hands and feet.

3. The most logical interpretation of the pedigree makes it appear that the character is an irregular dominant, as some individuals presumably heterozygous for the trait do not manifest it somatically.

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## "Putting a Floor Under the Family" in Uruguay

THE creation of "family estates" in Uruguay, with value limited to 5,000 pesos, exempt from all sorts of attachments, free from 50 per cent of taxes, and inalienable while the family contains minor children, was authorized by a decree of May 5, 1938. The purpose of the law is "to encourage thrift, to strengthen the spirit of family solidarity, and to insure protection of children up to majority and provision for their entrance into maturity under favorable auspices." (Data are from report of Augustin W. Ferrin, American consul at Montevideo, May 11, 1938.)

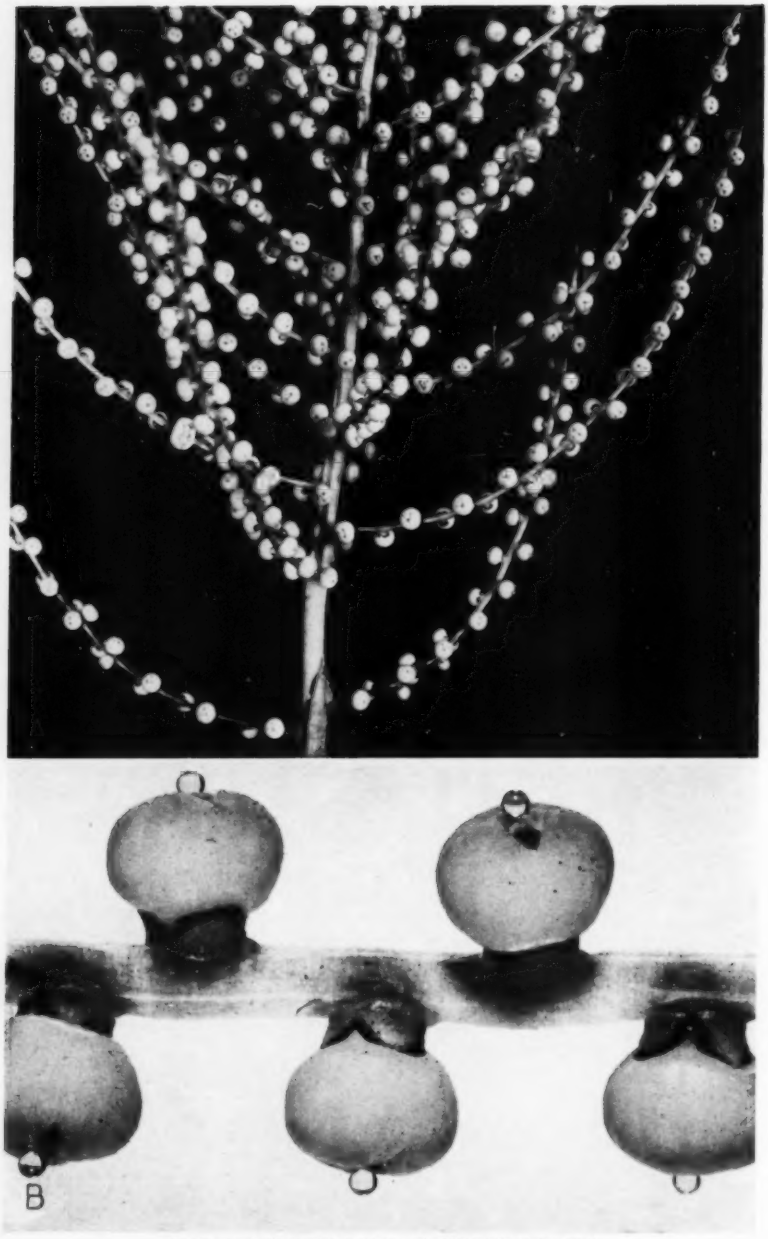
The family estate is to consist of the dwelling or rural property used by the family, including, moreover, the farm machinery and tools used upon the property, the farm animals necessary for its cultivation, four milch cows, and 6 months' supply of food and fuel for the family. (The food and fuel are unattachable also in cases which do not involve family estates.) Properties in any way pledged to the payment of an obligation cannot be made a part of a family estate.

* * *

The estate may be constituted by any person capable of disposing of his possessions, specifically, by the husband, or, upon his refusal, by the wife through judicial proceedings (with respect to property acquired during marriage); by the husband and wife jointly upon certain dower properties; by the wife upon certain dower properties; by the surviving or divorced spouse upon the personal property of either, in case there are minor children; by a grandparent having the responsibility for minor children orphaned or abandoned by their parents; and under certain circumstances, by natural father or mother.

* * *

From the time of this final act, the estate is unattachable both as to the property and its products, even in case of bankruptcy; it may not be disposed of except in case of reinvestment in another form, and its advantages cannot be renounced. However, the proprietor of the estate may sell all or part of it or may renounce its constitution, provided there are no minor children. In case of the death of either parent, the other continues the administration of the estate, and upon the death of both, the guardian of the minor children operates it for their benefit. — *Monthly Labor Rev.*, Oct., 1938.




**MALE FLOWERS OF *NEANTHE BELLA***

**Figure 15**

*A*—Lower part of male inflorescence showing habit of branching and arrangement of flowers, usually in opposite rows but with the flowers alternating. Note small apertures of flowers and nectar globules secreted by pistillodes as white points, also large fasciated male flower near left center. The enlarged male flowers, *B*, show the nectar drops which glisten in sunlight.

# NEANTHE, A PALM FOR GENETIC STUDY

## Variations in Form and Behavior

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HEREDITY has been studied in many herbaceous plants, and in relatively few of the woody, long-lived groups. No member of the palm order has been generally accessible to students of heredity, but a small palm from eastern Guatemala which is being introduced for household cultivation, appears also to be be well suited for genetic study in schools and laboratories.

**ADULT FOLIAGE OF THE HOUSEHOLD PALM**

**Figure 16**

A mature male palm five or six years old, in 6-inch pot, on an office desk, the inner leaves on longer petioles and held erect, facing a west window; two younger leaves with marginal bands connecting the pinnae.

Many palms are tolerant of shade and adapted to live as undergrowth in humid tropical forests or in crowded conservatories, but are too delicate to serve as house plants. The new palm is a native of rather open forests in the Maya area of northern Guatemala, where periods of drought occur, and this may explain why its moisture requirements are less exacting than those of undergrowth palms from deeper forests, so that it thrives in living rooms, offices, and laboratories, as well as in greenhouses and conservatories.

With the sexes on separate plants the usual difficulties of emasculating and bagging the flowers are avoided. Flowering and fruiting begin in the second or third season, and continue for 40 or 50 years, so that members of many generations may be available at the same time for comparative study. Experiments are facilitated by the succession of inflorescences through several weeks or months.

No distinctive strains or varieties of the Neanthe palm have been separated, but notable variations of form, structure and function have been found that may be of interest for genetic study. Several hormone reactions that attend fecundation and fruit development are also accessible to investigation in this material. These include the effects of different kinds of pollen, the abortion of adjacent pistils and female flowers, the formation of parthenocarps, and the swelling and coloring of inflorescence branches.

Several outdoor palms may afford material for comparison with Neanthe in the southern and southwestern States,

but in the northern States only greenhouses or conservatories could provide any palm material. Several palms have been grown as house plants, to a limited extent, but rarely reach the flowering and fruiting stages, though kept for long periods in conservatories. Even under natural conditions, twenty years or more may intervene between the generations of some of the larger palms. Such delays are a serious handicap in breeding work or in genetic experiments.

Neanthe is not closely related to any of the hardy palms or to others used as house plants. It is a member of the Chamaedorea family, a group of palms living in the undergrowth of tropical forests, from Mexico to Brazil, but chiefly in Central America. A hundred species or more belong to this family, none of large size, and all adapted to forest conditions, under the shade of taller trees. The largest Chamaedoreas have trunks three inches in diameter, the smallest a quarter of an inch. Some species grow singly, others with clustered trunks, from branched creeping rootstocks, or with only the creeping rootstocks to represent the trunks.

Several specialized genera have been distinguished in different regions in tropical America, but other writers continue to treat them as species of Chamaedorea. The species most frequently grown in conservatories are slender, long-jointed, reed-like types; the leaves fewer and larger than in Neanthe, the pinnae wider, and the inflorescences developed below the leaves. Some of the related palms may prove as well adapted as Neanthe to living rooms and laboratories, and may be generally available for comparison or crossing, but in other members of the family the foliage is more delicate, soon scorched by the sun or shriveled by dry air.

This palm dwarf was discovered in eastern Guatemala, in 1902, and was named as a generic type, *Neanthe bella*, in *Science* for August, 1937. A detailed account of the floral adaptations and methods of hand pollination was published with several illustrations in *The National Horticultural Magazine* for January, 1938. The genus Neanthe probably includes several species that have been grown in conservatories in Europe and in the United States as *Chamaedorea elegans*. The true *Neanthe elegans* has been recognized recently in California, with pinnae nearly a foot long and the secondary veins notably more prominent than those of *Neanthe bella*. In *Neanthe elegans* the calyx lobes are longer and more triangular, the pistillode smaller, with shorter rounded or truncate lobes instead of tridentate, and the center of the pistillode with a low triple prominence, whereas in *Neanthe bella* the pistillode has a central depression where nectar

**FOLIAGE PATTERNS OF NEANTHE**

**Figures 17 and 18**

Broad and narrow pinnae (opposite page) showing the range of variation in leaf form.

is secreted in some of the male plants.

### Diminutive Proportions of Neanthe

Although the form and habit of Neanthe are similar to those of large "palm trees," as dates or coconuts, the proportions are so reduced that the flowering stages often are reached in four-inch pots and full development is attained in six or eight-inch pots. The trunk is often less than half an inch in diameter and the leaf-blade less than a foot long, though somewhat exceeding these proportions in large specimens. Some of the Neanthe palms introduced in 1902 are still vigorous, five or six feet high, with 60 to 80 joints. The trunks are slender and graceful, with short well-marked joints separated by deep constrictions at the leaf scars, like those of the coconut palm, so that older specimens suggest dwarfed trees produced by the skill of Japanese gardeners.

The plants are of separate sexes, though not as strikingly different as in some of the dioecious palms. Even the flowers of the two sexes are similar in size and shape, small, globular and rather widely spaced on slender simple-branched inflorescences, the male flowers tending to be larger than the female and of deeper shades of yellow. The fruit clusters are more conspicuous than the flowering stage, with the mature branches turning deep orange or scarlet, and the round berries, green at first, eventually becoming deep purple, nearly black. Healthy seedlings have been raised from seeds produced on palms growing under living-room conditions, showing that the species is capable of complete domestication.

The small size of Neanthe is an advantage that is notably increased by stable habits of growth, each plant retaining the same form during its entire life history, extending through many years. The vigor of growth is reflected to an appreciable extent in the size and number of leaves that a plant may carry, but the cut or pattern of the leaves remains essentially the same, so that individual differences among the plants are readily recognized. A leaf crown of normal proportions usually develops in the third year, and the trunk does not increase in diameter after the first few joints are formed. The appearance of the plant does not change perceptibly from year to year, with the same conditions and care, except that more joints are added to the trunk.

### Comparing Several Generations

Neanthe not only germinates quickly, for a palm, in four to six months, but has a short juvenile period, only two to three seasons elapsing before flowering and fruiting begin, although the plants may live for 40 or 50 years. This makes it possible to breed and compare numerous overlapping generations in order to determine and demonstrate the effects of crossing or the successive stages of development of characters in select stocks. Long periods of germination and seedling growth are general among the palms and are a handicap in breeding work. Germination may require two years or longer, and the palms may pass several years in a simple-leaved juvenile stage before the adult leaf form is attained. Some of the palms begin to fruit as soon as the trunk-forming stage is reached.

but others defer fruiting until the trunk is 20 feet to 30 feet high, which may take a generation.

In the breeding of herbaceous plants it is usually not practicable to keep the same individuals alive from one year to another for comparison with progenies, making it necessary to use pressed herbarium specimens, preserved material, photographs, or drawings. Even with most of the perennial greenhouse plants, the annual renewal of the leaves, or the necessity of cutting back, may interfere with direct comparisons of leaves or other features. Neanthe retains its leaves for several seasons in a normal condition, thus allowing ready comparison of progeny material with parent stocks, and the same plant continues flowering and fruiting every year, from successive joints of the same trunk.

### Repeating Critical Experiments

In experimenting with annuals or biennials it is customary to keep stocks of seeds for repeating the tests, but this assumes complete uniformity and stability of a stock, of which we are never sure. Seeds may remain viable for only a few years, or cultural conditions may be so different that the same results are not obtained. The growth habits of Neanthe make it possible to retain in thriving condition all the plants used as parents by reason of any special characters, of the plants themselves or for determining progeny reactions. Even in a long series of breeding tests or genetic experiments, critical results may be checked to any extent, not merely with members of the same stock, but with the same individual plants.

For similar reasons, the important factor of individual variation is much more accessible to study in Neanthe, and the element of individual continuity is supplied to a greater extent than in any short-lived plants. A living record, showing all stages of a genetic investigation, may be kept until the series is complete, and the same material also insures the verification or repeated checking of any point requiring further tests.

### Control of Pollination

That the sexes of Neanthe are on separate plants has a critical relation to the use of the palm for educational or experimental purposes. The need of hand-pollination may appear as a serious handicap to the commercial florist, but is notably favorable for genetic study. All of the laborious precautions required in obtaining progenies of known parentage when working with perfect-flowered plants, such as removing the stamens or covering the pistils to exclude chance pollination, become unnecessary. The sexes may be kept in separate rooms, or individuals of either sex set apart for a few days during the period of pollination.

The flowers have such narrow apertures that unaided transfer of pollen rarely occurs, even with palms of the two sexes standing side by side. In the natural forest habitat in Guatemala, the flowers are visited by thrips and by minute beetles, probably Staphylinidae or Nitidulidae, which doubtless act as pollen carriers, there being little movement of air in the forest.

The successive inflorescences of a palm usually develop several days or weeks apart, so that pollen from different sources may be used with no risk of error by chance pollination. It is also feasible with simple precautions to apply particular pollens to different branches of the same inflorescence, or even to different flowers on the same branch, on account of the flowers standing well apart. By means of such differential pollinations not only the fertility of different crosses may be determined but also the extent and rate of development of the fruits.

The number of seeds produced on a plant is limited, since each flower matures only one seed, yet a mature female palm with three or four inflorescences may produce 500 to 600 seeds in a season, if most of the flowers are successfully pollinated. Younger palms have smaller inflorescences, but with many genetic experiments only a few plants are needed in the first generation of a cross.

Flowering at different times may interfere with the crossing of plants selected for studying the inheritance of particular characters, the active period of the flowers being only four or five days, but recent experiments have shown that pollen may be held for 20 days if flowering branches are placed in test-tubes and kept in cool storage, at 50 to 60 degrees. Longer periods of storage may prove feasible after the temperature relations are more definitely determined. The development of inflorescences may also be hastened or retarded where temperatures of greenhouses or laboratories are controlled.

**The Range of Variation in Neanthe**

Though only a few variations of Neanthe are given in this paper, the plant shows notable diversities in many features, from the seedling leaves and the joints of the trunk to the adult foliage, inflorescences, flowers, and fruits. The leaves and the inflorescences may be short and compact or slender, open and spreading, while the floral differences extend through sizes, shapes, shades of color, odor, and secretion of nectar from the pistillode. Some of the differences appear as rather definite contrasts, others in many gradations.

Compared with related palms, the trunk of Neanthe has very short joints, seldom longer than broad, the diameter less than half an inch in slender male plants, but sometimes approaching five-eights of an inch in robust female plants. In addition to the circular leaf-scar, each joint of a mature palm is flattened on one side where the inflorescence grew from the axil of the leaf below. The inflorescence scars show that the leaves and inflorescences are consistently in three ranks, though such regularity is not suggested by the general appearance of the plants.

The leaf-sheaths of Neanthe are from three to five inches long, much longer than the trunk internodes, so that several sheaths overlap and the outer sheaths are split to near the base on the side opposite the petiole. In texture and color the back of the leaf sheath is the same as the petiole, firm and deep green, sprinkled with whitish points marking the position of the stomata, but the margins of the sheaths are thin and scarious, pale at first, soon turning brown, and sometimes deeply fissured.

**Variation of Leaves**

The numbers and shapes of the pinnae and the spacings along the midrib are varied among the different plants, and determine the individual patterns of leaf-form, which often are so regular as to show striking contrasts among the plants, even where raised under uniform conditions. The number of pinnae varies from 11 to 15 on each side of the rachis in palms of fruitful age. The pinnae seldom are opposite, except the terminal pair, which usually are broader than the others. Three or four of the upper pinnae on each side of the leaf are notably shortened and usually somewhat narrower than those below, except that one or both of the lowest pinnae may be greatly reduced and set very close to the second pinnae.

Narrow pinnae usually are more widely spaced, the petioles longer, from eight to ten inches, and the plants more rangy, the leaf-crown sometimes spreading to three feet. The more compact plants may have petioles only five or six inches long, and the rachis scarcely longer than the pinnae, so that the leaf-blade as a whole is much broader than long. The broader and closer pinnae often show more tendency to curve downward at the tips, a feature that adds to the graceful appearance of the plants.

When growth is seriously checked by adverse conditions, notable changes of leaf form are induced, and then a gradual return to leaves of the normal form under better treatment. Such a series of leaf-forms is illustrated in the *National Horticultural Magazine* for January, 1938, suggesting that Neanthe may be of use for testing and demonstrating the effects of growth-controlling chemicals or of different cultural treatments. Where definite changes of leaf-form were induced, these could be compared to great advantage with the previous normal

**NEANTHE SEEDLINGS WITH FIRST LEAVES**

**Figure 19**

Young Neanthe palms in two-inch pots showing range of variation in shape and number of pinnae in the first seedling leaves. The upper plants typical with about eight curved pinnae, the others with three to ten pinnae, broad and narrow, short and long. (Natural size.)

form and the subsequent stages of recovery.

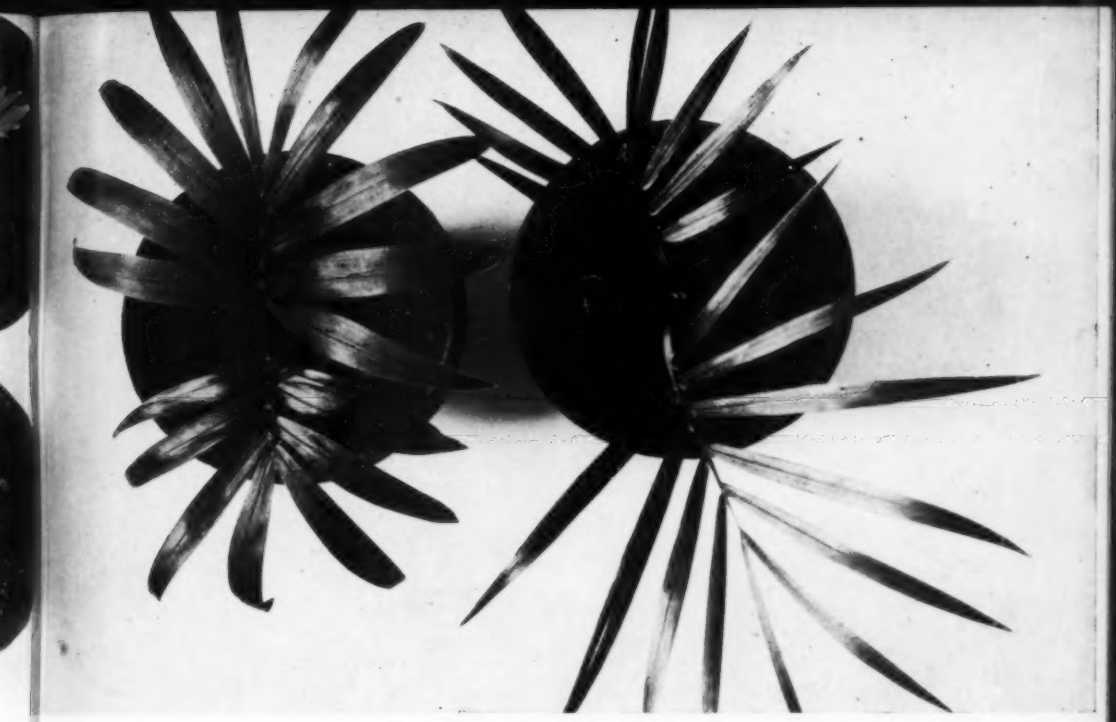
### Seedling Leaf Variations

The first leaf of Neanthe is compound like the adult leaf, while most of the palms have simple seedling leaves, linear or V-shaped, and this juvenile foliage may continue for several years before any compound "character leaves" are formed. Suppression of the simple-leaved stage may account for Neanthe flowering very early, in the second or third season. Two bladeless sheaths are present below the first expanded leaf as in related palms.

Differences of color, size, and number of pinnae are apparent as soon as the seedlings have opened their first leaves, as the photographs show. The remarkable range of variation may mean that the compound seedling leaves, not shared in related genera, are a rather recent step in evolution. The change would seem to have been accomplished, not by developing a new character, but by suppressing a former simple-leaved stage. Many of the variations may be viewed as reversions toward a simple seedling leaf, and as different degrees of approximation to the adult leaf-form.

The first leaf usually has eight pinnae, four on each side, but as many as 12 pinnae have been noted, and these very narrow. In other seedlings the segments of the first leaf may fail to separate, resulting in only two or three unequal divisions on each side (Figure 19). The second leaf is often no larger than the first, and in rare cases is distinctly smaller, but usually the pinnae are more numerous and the petiole longer.

The flowers of Neanthe are unusual in the palm group, the petals firmly fused and the opening narrow, with the stamens and stigmas fully enclosed and protected against drying. The large peltate pistillode is a remarkable specialization, the broad green top nearly closing the aperture of the male flower, and so



**NEANTHE SEEDLINGS—TWO-LEAVED STAGE**

**Figure 20**

Two plants with first and second seedling leaves, showing extremes of variation from broad compact pinnae to narrow and widely spaced. Such variations in leaf form are maintained throughout the life of the plant. (Natural size.)

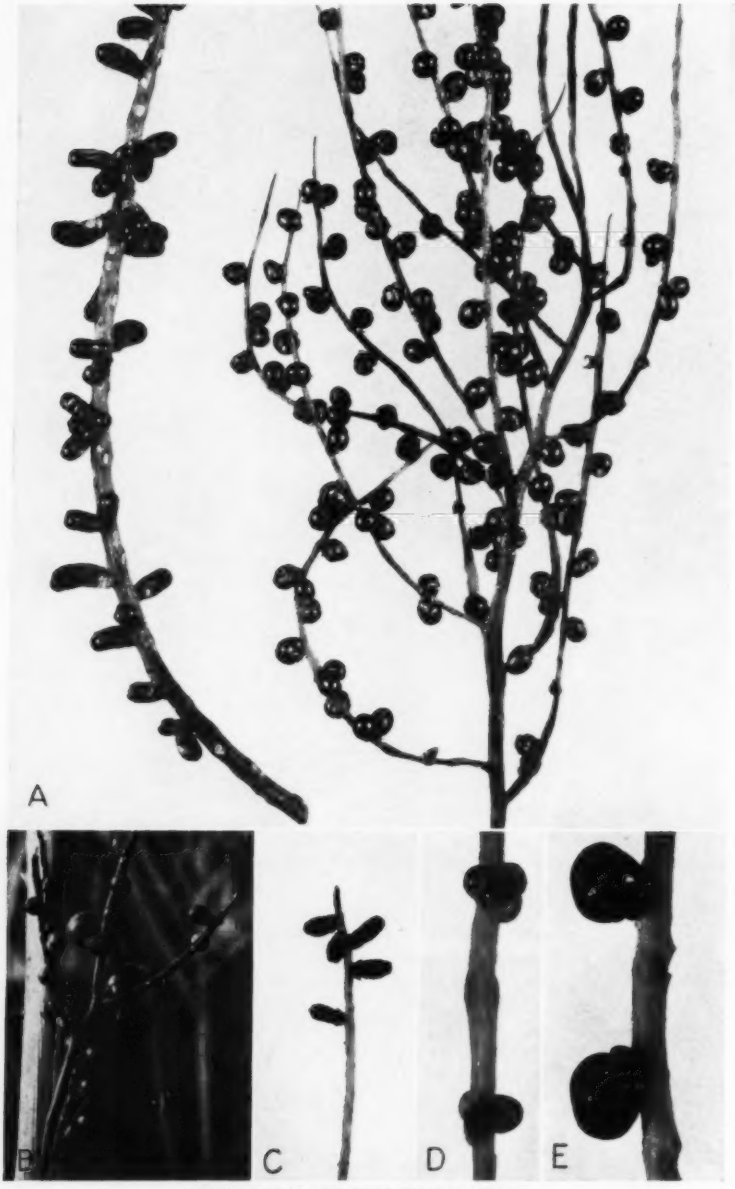
much larger than the functional pistil of the female flower that the sexes have been confused. Many other palms have rudimentary pistils in the male flowers, but usually as minute structures or slender and white like the filaments.

The green color of the pistillode suggests a special function, and a drop of nectar sometimes is formed in the central depression, glistening brightly when reached by sunlight. The secretion has not been observed on many plants, but in some of them has appeared on successive inflorescences, several weeks apart. The drops remain on the pistillodes even of withered flowers, gradually contracting and becoming more viscid. A possible function of the nectar secretion may be the withdrawal of moisture from the stamens, thus allowing the anther cells to open and release the pollen. The female flowers are smaller than most of the male flowers, and the triangular aperture is not obstructed, the short divergent stigmas rising but little above the middle of the cup and showing only a slight viscid secretion.

**Variations of Inflorescences**

Differences in size, proportion, branching, and coloration are noted among the inflorescences. The length of the stem or peduncle varies from four or five inches to 12 or 15, occasioned by differences in numbers and lengths of component joints. Usually there are five to seven joints, the two lowest about half an inch long, the others gradually longer, with all but the last joint bearing small tubular spathes, and the tip of the upper spathe usually overlapping one or two of the basal branches.

The branching axis of the inflorescence may be only an inch long on small female inflorescences, but three to five inches long on large male inflorescences, and the number of branches may vary from four or five on small female inflorescences to 30 or more male branches. On small and medium inflorescences, all of the branches usually are simple, but




**ABNORMAL FRUIT-FORMATION**

**Figure 21**

Female inflorescences which are not pollinated, or which are exposed to pollen of other species produce most useful examples of parthenocarpic development. The upper photograph (*A*) shows seedless parthenocarpic fruits normally produced by *Neanthe bella* (right), and a related palm, *Chamaedorean concolor* (left). *B* shows spherical abortive fruits produced on a related Costa Rican palm by *N. bella* pollen, and *C*, smaller oblong abortive fruit produced by *Ch. concolor* pollen. *D* shows three-carpel parthenocarps of *N. bella*, and *E* the more usual one-carpel type (equally enlarged).

on large male inflorescences one or two of the lower branches may be forked near the base, or in rare cases more of the branches may be forked. A single female plant with rather large inflorescences has many of the branches forked two or three times, though in other respects appearing normal and fruiting abundantly. Earlier ripening of the fruits was noted, in nine months, and prompt germination of the seeds, some of them in 70 days, under greenhouse conditions.

Occasionally branches are developed on the lower spathe-bearing joints of the peduncle, which normally have no branches. The joints of such inflorescences are abnormally long, and the inflorescences sometimes twice the length of others on the same plant, while in other individuals the tendency to long inflorescences and to branching from the lower nodes is more or less regularly repeated, sometimes with two or three such branches. A preponderance of branch variations in female plants is indicated, under similar growth conditions. Among 23 female plants, five were found with extra branches, while of 54 male plants only two showed extra branches.

Two or three inflorescences developing in the same leaf-axil may be associated with branching from the lower joints of the peduncle. Three such cases have been observed, a female which developed three inflorescences from the same leaf-axil, and two male plants with two inflorescences at the same node.

The female flowers and the branches of the inflorescence are somewhat accrescent, the calyx and corolla becoming larger and the branches somewhat thicker with the development of the fruits, and the color changing from green to yellow, eventually to deep orange or scarlet. The extent of thickening and the intensity of color are subject to appreciable variation, some of the female plants thickening and coloring their inflorescences even though bearing only parthenocarps, while other female plants have less persistent inflorescences and less tendency to form parthenocarps.

**Persistence of Mature Inflorescences**

The persistent vitality of the female inflorescences and the pericarps is an adaptive feature shared by Neanthe with the commercial "Kentia" palm *Denea forsteriana,* where the pericarps retain their green color indefinitely, so that several successive crops of mature fruits may be retained through a period of years, as described and illustrated in this JOURNAL for September, 1927. The fruits of Neanthe attain a quarter of an inch in diameter, reaching their full size in three or four months after pollination, though usually requiring 9 to 12 months to ripen and turn black. Yet at that stage of maturity the fruits do not shrivel or fall off for several months, and may be retained for an entire year or longer, with the supporting inflorescence remaining alive, which keeps the fruits from drying. This persistent vitality of the inflorescences and the long retention of the fruits obviously is an adaptation, and in nature undoubtedly increases the chances of the seeds surviving to the rainy season, and of being distributed by birds. Also for breeding or experimental work, the retention of the fruits is a notable convenience. Since the seeds are too perishable to be kept in storage, many separate harvestings and plantings would be required if the fruits fell off at maturity. That inflorescences with parthenocarps also persist for many months, seems to confirm the indication of a definitely established character.

The relations of the parthenocarps to the thickening and yellowing of the branches are somewhat different from those of the normal fruits, to the extent that these changes are confined to sections of the branches below the parthenocarps, while the sections beyond the parthenocarps remain slender and green, and that branches bearing no parthenocarps remain green, while all of the barren branches thicken and turn orange-yellow on inflorescences that develop even a single normal fruit. The largest crops of parthenocarps have developed on mature plants in deeply shaded greenhouses, none on young palms un-

der household conditions. Abortive fruits have developed in a few cases on household plants, but only on inflorescences that had been pollinated.

### Parthenocarps, Lipocarps, and Telecarps

Female inflorescences that are not pollinated often produce parthenocarps, usually by the enlargement of a single carpel, while on other palms all three carpels are equally swollen, though in such cases a relatively slight development takes place, and only a slight thickening and coloration of the branches. (Figure 21). The one-carpel type is far more common, with the parthenocarps to all outward appearances like the normal fruits, though not attaining full size, and the branches not so much thickened and colored as with seed-bearing fruits.

Some writers use the term parthenocarp for seedless fruits, including those formed as a result of pollination, on the assumption that the pollen in such cases has only a "stimulative" effect, though even this would need to be distinguished from a spontaneous vegetative growth of parthenocarps. Seedless fruits of the African oil palm *Elaeis guineensis* have been described by Yampolsky, with the following remark: "Whether this fruit is truly parthenocarpic or whether it is the result of fertilization followed by abortion . . . has not been determined." (*Bul. Jard. Bot. Buitenzorg* III, 5:143, 1922).

On Neanthe plants that are not producing true parthenocarps, weak or defective pollen may induce the formation of abortive fruits. Pollen stored in a test tube for five days at room temperatures produced only abortive fruits, while with pollen kept for three days, or even for two days, under the same conditions, some of the fruits were seedless while others attained a full development. For abortive fruits that result from pollination the name *lipocarp* might be used, to indicate that development begins, but is not completed.

Parthenocarps and lipocarps of Neanthe need not be confused since they rarely would occur together, on the same inflorescence. The pollination of even a few flowers of a Neanthe inflorescence induces a prompt shedding of all the flowers that are not pollinated, or at least those adjacent to the pollinated flowers. Most of the lipocarps are formed from a single carpel like most of the parthenocarps and all of the normal fruits, but many twin and triplet lipocarps developed on three female palms that had been pollinated from a single male palm. The lipocarps on one of the female palms remained small, but those of the other two palms developed to nearly the size of normal fruits, and then shriveled.

A need of further distinctions appears when different forms of abortive fruits are produced on the same palm, as occurred on a female palm from Costa Rica, a cespitose species with rather slender long-jointed trunks, probably to be identified as *Chamaedorea costaricana*. Only female plants are available, and none has produced parthenocarps. Neanthe pollen produced on this palm abortive fruits of nearly spherical form, some of them twice the size attained by normal Neanthe fruits, while with pollen of a solitary reed-like palm, *Chamaedorea* species, the seedless fruits were cylindric-oblong, twice as long as broad, much smaller than the spherical fruits, and ripening in a much shorter period.

These effects of pollen on the fruits are analogous to those described by Swingle as *metaxenia* in the JOURNAL for June, 1928. Differences in size and period of ripening of the fruits were demonstrated in experiments with commercial date varieties pollinated by other species of Phoenix. Xenia, "the immediate effect of pollen," is shown in differences of color or texture in kernels of maize from different kinds of pollen, but these effects are explained by the nature of the endosperm of the seed. Metaxenia is distinct from xenia because the pericarp tissues, viewed morphologically, are not products of fertilization like the embryo and the endosperm, but are derived from the female plant, so that modifications of these

tissues are not to be viewed as a direct inheritance but as one of the hormone reactions, as Swingle explained.

The production of seedless fruits showing characters of the pollen parent may be described as telecarpy, signifying a long-range effect, beyond metaxenia, between types too different to form hybrids, reminiscent of the discredited phenomenon of telegony, and possibly to be interpreted in the same manner, as induced reversions. Interest in parthenocarps, lipocarps and telecarps no doubt will lead to detailed physiological studies of the Neanthe palm and the related genera.

**Breeding Stocks Being Established**

With the sexes on separate palms and the inflorescences remaining functional for only a few days, opportunities of pollinating the female flowers and raising seeds are not assured if only one palm of each sex is at hand. To have the two sexes in equal numbers may be less important than having several male palms to draw upon when pollen is needed. A dozen palms or more are desirable as a basic stock for raising seed of Neanthe, and such stocks are being established at several universities, experiment stations, and botanic gardens, with a view to more rapid propagation. Successful pollinations are reported, even in the first season, with rather young palms. Material not needed for purposes of instruction or experimentation may become available gradually for establishing the palm in domestic use.

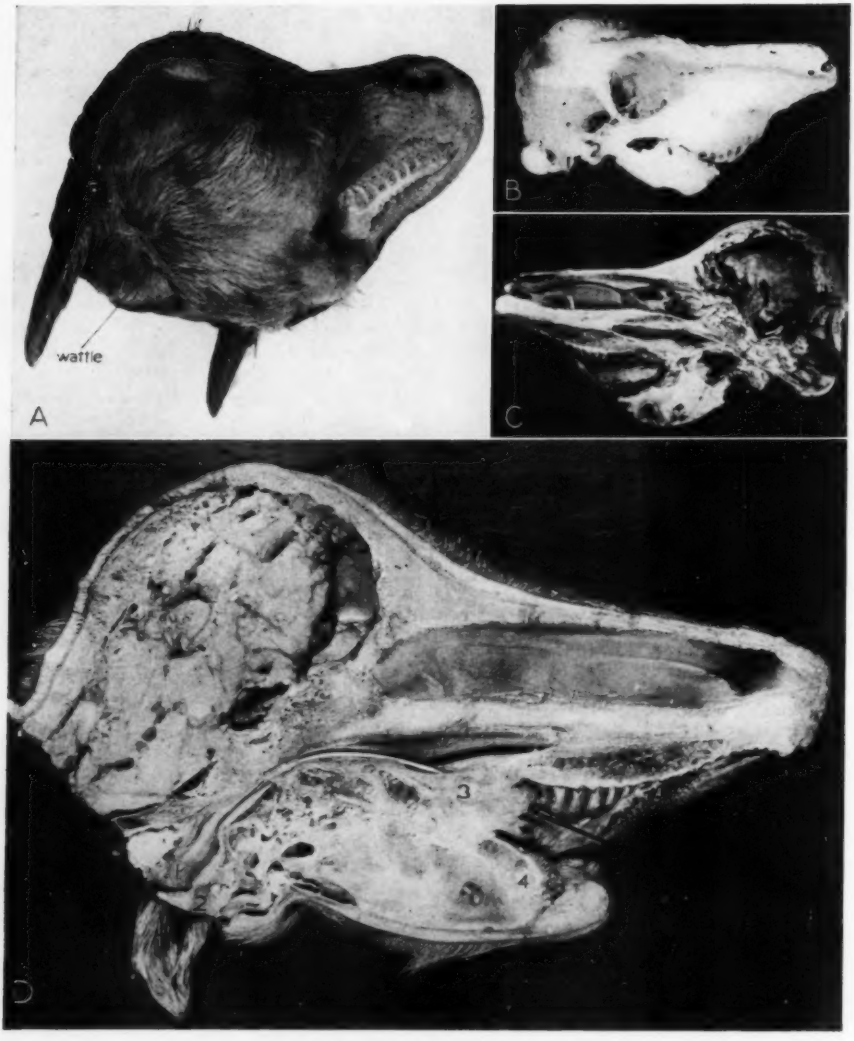
Community groups may be organized where several persons living in the same neighborhood are sufficiently interested to pollinate the flowers and raise seeds or seedlings for the community, or horticultural agencies may be enlisted to undertake the pollination and propagation of Neanthe on a commercial scale. A regular production of seed in commercial quantities would require still larger groups of palms as basic stocks, three or four dozen plants.

In view of the several characters that arouse interest and facilitate scientific study, Neanthe eventually may become one of the best known palms. Thriving and fruiting under household or laboratory conditions is a unique behavior among the palms, with further advantages of maturing early and living through a period of years, so that several overlapping generations may be grown, for intensive comparison of successive stages of development of particular characters. No other palm affords similar opportunities for determining the inheritance of variations or effects of crossing on habit and foliage characters, for observing the floral specialization of the two sexes, or for following the processes of reproduction and development.

✦

**Sleeveless Research Errands**

. . . . In recent years "fact finding" has been an academic fetish. Refusal to relate facts to theoretical organization of the subject, and to draw tangible conclusions, has been recently carried to the point of sheer cowardice. The pious hope has been indulged that after us will come a builder, who will weld isolated fragments of information into a cognate, useful structure of knowledge. Well, the century is hurrying. It is about time that we not only gathered facts, but began to ask questions of facts. — Adolf A. Berle, Jr., in *Ann. of the Amer. Acad.*, Mar., 1938.




**"JAWLESS" CALVES**

**Figure 22**

Views of the head and skull of agnathic fetuses, described in detail in the article. *A*, Latero-ventral view of the head of Fetus *A*; *B*, Lateral view of skull of Fetus *B*, 1—parmastoid process, 2—bulla ossea. *C* is a sagittal section of the same and *D* a sagittal section of the head of Fetus *A*; 1—esophagus, 2—epiglottis, 3—soft palate, 4—tongue. The wattle shown in *A* is the first observation of such an appendage in cattle. Fetus *B* also had wattles.

# AGNATHIA, A NEW BOVINE LETHAL*

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OUR knowledge of bovine lethals is limited in a large measure to reports of foreign workers although undoubtedly many occur in this country which are not reported. Breeders are frequently slow to admit that abnormal calves have appeared in their herds because in their opinion it seems to indicate a lack of "purity of blood" which they are unable to account for, and a reputation which they do not cherish.

Hutt[3] reported ten bovine lethals in 1934, five of which may be described as skeletal deformities. Eaton[1] in his review of 1937 describes fourteen bovine lethals, seven of which deal with malformed bones. In each of these reviews mention is made of a report of Mohr,[6,7] who describes an ankylosis of the articulation of the lower jaw, together with a shortened lower jaw occurring in Norwegian Lyngdal cattle; Ljutikov[4] of the Institute of Animal Breeding, Moscow, has reported a dwarfed male inbred calf with deformed lower jaw. An "agnathous" character is mentioned by Heizer and Hervey[2] but it was not described in their report of impacted molars. Agnathia is defined as absence or imperfect development of the jaws.

Williams[10] reports fifteen bovine monsters, a majority of which occurred in dairy cattle. He attributes their occurrence to faulty methods of husbandry during the early life of the parents. Many pathologists will agree with his views which offer a very reasonable explanation for the occurrence of monsters. His belief is that there is no certain time in the life of an individual when disease will cause death, but when disease involves the ovum, embryo or very young fetus, complete recovery may occur prior to birth. "Sometimes partial repair occurs and a monster is aborted or born." However, where several identical or very similar abnormalities appear among closely related individuals, it points definitely to heredity as a reasonable explanation.

Four cases of agnathia in the past eighteen months have come to the attention of the authors. All were male Jersey fetuses and three of these (*A*, *B*, and *C*) appeared in the herd of the Kentucky Agricultural Experiment Station, where adequate facilities were available to study them in some detail.

### Description of Agnathia

Fetuses *A*, *B*, and *C*, showed identical head abnormalities if allowance be made for the differences in age. Since fetus *A* was carried full term and was normal in size, it is described in detail.

A latero-ventral view of the head after it had been removed at the atlanto-occipital articulation is shown in Figure 22*A*. The lower jaw is 8 cm. shorter than the upper jaw. The abnormal position of the ears was caused by fixation of the specimen in formalin. Wattle-like appendages occur on each side of the head midway between the base of the ear and the angle of the jaw. These appendages are .5 cm. in length and .25 cm. in width. Several coarse, black hairs grow from each of them.

A sagittal section of the head of calf *A* made slightly to the right of the median plane is pictured in Figure 22*D*. The mandible consists of osseous, soft and tooth tissues crowded together into an irregular mass that fills the mandibular space. This mass of tissue extends dorsally until it almost obliterates the

*The investigation reported in this paper is in connection with a project of the Kentucky Agricultural Experiment Station and is published by permission of the Director.
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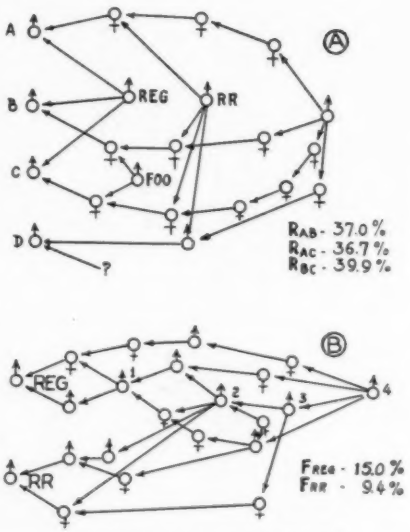
pharynx and separates the epiglottis from the posterior part of the soft palate. In a normal individual these are in close apposition but in this case these structures are seven cm. apart. From the appearance of these structures it would seem impossible for this animal to have breathed or swallowed. A probe indicates the extent of the pharyngeal cavity. The osseous base of the hard palate is thickened dorso-ventrally. This head was not examined until it had been preserved for some time; however, the shape of the head and the condition of the brain indicate a slight hydrocephalus. The lower lip does not extend past the first upper premolar. An x-ray picture does not show any evidence of incisor teeth. The tongue is pushed anteriorly and is quite small.

Figure 22*B* and *C* shows the attachment of the mandibular mass to the zygomatic process of the temporal bones. There is complete ankylosis of the temporo-mandibular articulation. The coronoid process of the mandible is absent. No evidence of the hyoid bone was found.

The superficial blood vessels on the right side of the heart of fetus *A* were varicose. There were several black spots under the epicardium near the apex of the right ventricle. Histological sections showed that these spots were small hematomata. There were cyst-like prominences under the epicardium of the right auricle. The heart of fetus *B* showed the same characteristics. There was no opportunity to examine the hearts of fetuses *C* and *D*. The authors are unable to state whether this heart condition has any relationship to the agnathic condition described .




**AN AGNATHIC PEDIGREE**

**Figure 23**

The relationship of the agnathic fetuses *A*, *B*, *C*, *D*, is shown in *A*. *B* shows the degree of inbreeding in the common ancestors of the deformed calves.

## Case Histories

Fetus *A* — From dam E. 211. The dam was born June 26, 1932, and raised in the Experiment Station herd. She was a vigorous well-grown heifer, first bred September 26, 1933, again October 19, 1933, and a third time December 30, 1933, which resulted in the birth of a dead fifty-five pound male calf on October 6, 1934, carried 280 days. All three services were by the same sire, Fairy's Oxford Observer. A persistent corpus luteum was removed from the right ovary on November 15, 1934, and a small cyst was removed from the same ovary on December 28, 1934. She was bred January 7, 1935, to Noble Plymouth Gauntlet and on January 27, 1935 and February 15, 1935, to Raleigh's Eminent Gold which service resulted in the conception which produced fetus *A*, which weighed 58 pounds, was carried 280 days, and born dead. Typical agnathia.

Fetus *B* — From dam E. 238. The dam was born June 21, 1933, and raised in the Experiment Station herd. She was also a strong, vigorous heifer, seemingly normal in every way. First bred September 19, 1934, to Hebron's Lord Raleigh followed by three more services, October 12, 1934, November 2, 1934, and December 5, 1934, to Noble Plymouth Gauntlet. She was in heat December 29, 1934, and not bred. She finally conceived to the service of Raleigh's Eminent Gold on January 22, 1935. She carried the normal male calf 288 days, which weighed 54 pounds at birth. She was rebred February 13, 1936, to Raleigh's Eminent Gold. On May 15, 1936, she was in heat and passed slightly bloody mucus. In our opinion she had aborted a 75 to 80 day old fetus which was never found. She was again bred May 15, 1936, and again June 7, 1936, to Raleigh's Eminent Gold, the last service resulting in conception. On November 3, 1936, E. 238 was slaughtered in connection with the securing of other data. Post mortem examination revealed the male fetus *B* which

was normal in size and development except for a definite agnathic character.

Fetus *C* — From dam E. 307. The dam was born February 19, 1935, raised in and is still a part of the Experiment Station herd. Three services to Raleigh's Eminent Gold were required for a first conception, June 2, 1936, June 28, 1936, and following several heat periods at which time she was not bred she conceived to a service September 9, 1936. On January 2, 1937, 116 days later, she aborted Fetus *C*. This fetus was about the size of a 75 day old fetus and it is our belief that death had occurred at about that age. Even though it was somewhat macerated, the agnathic condition was very apparent. The dam E. 307 was rebred to Raleigh's Eminent Gold on February 16, 1937, which service resulted in a normal 48 pound female calf carried 274 days, numbered E. 411 in the herd records of the Experiment Station. Again she was rebred to the same sire on January 17, 1938, resulting in conception. A normal calf was born October 3, 1938.

Fetus *D* — From a grade Jersey cow known as "Bob No. 2" in a Jersey herd near Bowling Green, Kentucky. As described by the owner "It was a bull calf with no lower jaw." This fetus was sired by a son of Remarkable Raleigh from the Kentucky Agricultural Experiment Station herd. It was not seen by the authors but the owner of the dam reported that it was born dead on approximately the date it was due.

## Genetic Analysis

The relationship between the agnathic male fetuses is shown graphically in Figure 23*A*. *A*, *B*, and *C* were each sired by Raleigh's Eminent Gold (*REG*). *A*'s dam is by Remarkable Raleigh (*RR*) as were also the maternal granddams of *B* and *C*. The dams of *B* and *C* are by Fairy's Oxford Observer (*FOO*). *D* is sired by a son of (*RR*) out of a grade cow of unknown breeding. The high relationship coefficient between the three fetuses *A*, *B*, and *C* indicates to us that the defect is inherited. These relationship coefficients as calculated from the formula by Lush,[5] reveal practically the relationship of three-quarter brothers.

Figure 23*B* illustrates graphically the degree of inbreeding and the relationship to common ancestors of the sires most closely involved in this study. Raleigh's Eminent Gold (*REG*) is a double grandson of bull (1) which in turn is a double grandson of bull (2). Bull (2) is also the maternal grandsire and paternal great grandsire of Remarkable Raleigh (*RR*). More remote common ancestors are noted in bulls (3) and (4). The coefficient in inbreeding according to formula of Lush[5] is 15.0 per cent and 9.4 per cent respectively for Raleigh's Eminent Gold and Remarkable Raleigh.

Remarkable Raleigh (*RR*) sired 23 male calves in the Experiment Station herd, none of which showed the agnathic character.

Fairy's Oxford Observer (*FOO*), the sire which followed Remarkable Raleigh, sired 28 male calves, 14 of which were from daughters of Remarkable Raleigh. There were no agnathic calves in this group.

Raleigh's Eminent Gold sired 24 male calves, seven of which were from daughters of Remarkable Raleigh. Three of the seven were from one dam (E. 194) and all were normal. This seems to indicate a possible homozygous dominant (normal) genotype for E. 194. One of the remaining four showed the agnathic character. Raleigh's Eminent Gold to date has sired nine male calves from granddaughters of Remarkable Raleigh. Assuming a 1:2:1 ratio of genotypes among these granddaughters, the occurrence of two cases of agnathia among them approaches the expected 3 to 1 ratio.

The senior author has corresponded with several breeders who have long been identified with Jersey herds closely related to Raleigh's Eminent Gold and Remarkable Raleigh. None of these men have ever encountered the agnathic character in their rather extensive breeding operations.

The Kentucky Agricultural Experiment Station herd has been entirely negative to Bang's disease, tested in low dilutions, for the past six years. A complete life history is available for each female in the Jersey herd for the past 32 years. No other cases of agnathia have been recorded during this time.

## Conclusions

Although numbers are small the data reported herein seem to indicate:

1. That the agnathic character is inherited as a recessive and it is assumed

that the character is limited to the male sex as no case has ever been reported in a female.

2. That two recent Jersey sires, Raleigh's Eminent Gold and Remarkable Raleigh, which were used in the Kentucky Agricultural Experiment Station herd were heterozygous for the defect and that Fairy's Oxford Observer did not carry this recessive defect.

### Summary

1. Data are reported on four cases of agnathia.

2. This defect is described and case histories are related in some detail.

3. The relationship of animals involved is indicated.

4. A possible explanation for the occurrence of the defect is offered.

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## A QUARTERLY EUGENICS SECTION

BEGINNING with this issue arrangements have been completed with the American Eugenics Society to publish during 1939 a quarterly 16-page supplement to the Journal of Heredity dealing with various phases of the general subject, "Eugenics Today." We have had some discussion in the Journal in the past few years of possible planks for eugenic platforms. It is felt that developments in eugenic thought, both here and abroad, have in recent years reached a point where a complete and critical re-evaluation of eugenic philosophy and of proposals for action is necessary if the eugenic point of view is to have any place in directing human biological and social conservation and evolution. To give the background of these recent developments, and to foster useful speculation on likely ways and means to apply the "New Eugenics" to present-day problems, will be a major aim of this section during the current year.

The revolution in eugenic thinking which has been taking place might be appropriately labeled "The Democratic Approach to Eugenics." The original Galtonian eugenics was distinctly an affair of a chosen class and of a chosen nation even. As Pearson emphasized, Galton "would not allow the word 'National' to be omitted from his definition of eugenics." It would not be easy, however, to fit such a class-conscious program into a democratic system — even assuming that merely by dealing with classes of the population as *classes,* appreciable eugenic progress were possible. This proposition has, as a matter of fact, never been proven, — and with present birth rates there is a distinct possibility that such an approach might result merely in hastening an alarming decline in total population.

It appears that in Sweden and in the United States revolutionary approaches to a eugenic philosophy have independently been evolved during the last five years. Some of these new developments are discussed in the succeeding pages. When we consider that these two schools of eugenic thought (the Swedish group call themselves populationists, rather than eugenists, by the way) were developed entirely separately, the parallelism of their philosophy is remarkable. Whether the premises on which they are based prove sound in social and political practice remains to be seen. Certainly they are no more based on theory and unproved assumptions than are some of the "for granteds" of the "classical school," and they may base more solidly on man's biological background than some of the older postulates. There has been much uncritical talk about the fundamental impossibility of reconciling democracy and eugenics. Perhaps the irreconcilables aren't so antipodal after all, as Mrs. Myrdal points out in her discussion of the Swedish plan. Certain postulates, always heretofore offered as alternatives, turn out not to be inevitably mutually exclusive,—we have just persisted in thinking of them in that way. In the same way the political postulate of equality before the law did not necessarily imply the biological identity of all human beings — who obviously differ in a great many characteristics, but who are alike in all having legs long enough to reach the ground. These basic distinctions were apparently recognized by the framers of our Declaration of Independence and Constitution, and that there has been much silly thinking since proves little except the need to get rid of some futile preconceptions and get back to realities.

The new approach to eugenics does essential pioneering really in taking a realistic look at that portion of Galton's definition which accepts as the motive power of eugenics a study — and by implication an application — of *agencies under social control,* which might be expected to affect the well being of the race. The early followers of Galton were not very realistic in their approach to this problem in a Democracy. Compulsive measures obviously were only of limited value, yet these were about all that was considered. Mere persuasion on a highfaluting plane would hardly be more effective. What are the other possibilities? The problem of balancing the real and assumed needs of the individual against the needs of society as a whole is never going to be solved to the complete satisfaction of either party, but in many fields of human activity we are continually making the attempt — and developing workable compromises. One of the great eugenic documents so far written is that penned by Justice Holmes in the case of *Buck vs. Bell.* This decision looked at some of the agencies under social control which deal with one aspect of the eugenic problem. To quote out of context usually distorts, but there is a deal of significance in the statement that "we have seen more than once that the public welfare may call upon the best citizens for their lives. It would be strange if we cannot call upon those who already sap the strength of the state for these lesser sacrifices . . ." . . . "The principle which sustains compulsary vaccination is broad enough to cover cutting the Fallopian tubes."

The right of the group to exercise compulsion when essential for the common good, and when other methods fail, is necessary under any social system. Since human culture is a matter of social organization, it is not likely that we shall soon do away altogether with this unpleasant necessity. There is a world of difference in the limits within which compulsion, persuasion and education will be applied, and the non-compulsive agencies under social control are really the key to the development of a democratic eugenics. It is this background of eugenic action which needs to be explored and discussed. And it is hoped that this cooperative arrangement will give all of us new insights and a new understanding of the approaches and possibilities of eugenics in 1939.—EDITOR.

## *THE AMERICAN CONCEPT OF EUGENICS*

*IN the United States today many people are striving to improve the conditions of human life. Those who so are engaged recognize the fact that individuals differ in their native capacity to respond to an improved environment. We are all environmentalists, and we are all all hereditarians, too, especially when we can see our way to eugenic measures which will not conflict with, but rather supplement, other social ideals.*

*Such a eugenic program is now in the making. It goes beyond the simpler genetic traits, to that complex inheritance which makes possible high social values. Some of the traits which have a simple genetic origin and are little affected by the environment include certain hereditary physical defects, certain hereditary mental diseases, and a large proportion of feeblemindedness. It is clearly the responsibility of doctors and public health authorities to discourage childbearing among hereditary defectives.*

*But the gradual diminution of defective genes will not greatly improve the average person's capacity for developing intelligence and socially valuable traits of personality. Here we are dealing with qualities which are developed by the environment acting on a complex group of genetic factors. Differences in these genetic factors were once attributed to our various occupational, or regional, or racial groups. Now we know that there is hardly any scientific evidence on innate differences of large groups. In a period of declining births, we can not afford measures which would further diminish births among competent people in any group.*

*It seems, therefore, clear that the eugenic program must be directed to influencing births among individuals, rather than among groups or classes, with particular emphasis on increasing births among parents whose socially valuable qualities rise above their neighbors', in whatever environment they may be found.*

*Preliminary to the introduction of eugenic measures, improvements must be made in the social and economic environment. First, economic handicaps attaching to parents who have large families should be diminished. This means that society must contribute new items toward the cost of rearing children, just as it already contributes to the cost of their education. It would then be possible for those desiring large families to have them without too seriously lowering their level of living. Second, married couples who desire to space their children or to limit their number should be equally able to do so, whatever their economic level, or wherever they live. This means making birth control widely available.*

*We are justified in believing that conditions which restrict the freedom of parents to choose the number of children they will have are barriers to eugenic social ideals. As these barriers are removed it should be possible to develop practical eugenic measures.*

*True eugenic measures would have to do with human motivations and human ideals. In this period of declining births, they would be directed chiefly at increasing the desire for children among people at or above the average in hereditary capacity for responding to a good environment. Such measures would start with the education of the child in the home, follow through school and college, and be incorporated in the activities of all existing social agencies. This in brief, is the comprehensive program of eugenics. It implies freedom of parents to decide how many children they will have together with more help in rearing them; and it requires new aspirations, new motivations, and a new eugenic social consciousness such that on the whole the more competent parents will have the most children.*

*Such a eugenic program is in accord with democratic ideals; it would supplement all other efforts at social advance; it would tend to improve the environment in which children are reared; it would leave room for many different types of human culture. It would have only one universal requirement, that every type of environment should provide conditions in which those persons above the average in their hereditary capacity to respond to the best in that environment should have the most children.*

*It is for those already engaged in the work of improving human conditions to tell us whether their efforts can also include training in those motivations, interests, and desires, which make for love of children, interest in family life, and a desire to participate in proportion to one's abilities in the highest of human functions, the bearing and proper rearing of children.*—FREDERICK OSBORN.

# THE SWEDISH APPROACH TO POPULATION POLICIES

## Balancing Quantitative and Qualitative Population Philosophies in a Democracy

ALVA MYRDAL

IN the turmoil of contemporary fascist and communist population experiments, Sweden has, during the past decade, set herself the task of trying to formulate a democratic population policy. When such a country, being or striving to become an enlightened democracy, faces a catastrophic decline in her population in the near future, neither force nor ignorance can be relied upon as a remedy. Thus a democratic solution to the problem which the totalitarian states have been wrestling with through propaganda, baby bonuses, et cetera, had to be found.

The ever-present concern which we feel in Sweden about the quality of population became united with a flare-up of interest in the quantitative destiny of the people. In recent years Sweden has been found near the bottom of the roster of nations classified according to birth rates. Ignoring here the captivating task of causal explanation, it may merely be mentioned in passing that as early as 1925 the net reproductivity of Sweden had passed below the replacement level. Depending on different bases of calculations the reproductive index has oscillated between 700 and 800, where 1000 would imply a stationary population. This means a loss of about a quarter of the population in a generation, for 100 newborn girls will leave on the average only about 75 daughters.

In planning to meet this emergency it was essential to take stock of demographic changes and their causes and also of social conditions with the main emphasis on the part played by deficiencies in our social organization which contribute to the crisis in births. Upon these foundations a population program was formulated with concrete plans drafted in 17 reports by the Population Commission, called in 1935, and in some ten related reports by other Royal Commissions. The first reforms proposed as a result of this survey were enacted in 1935, and most of the new legal provisions went into effect January 1, 1938. Some are still only proposals, or thoroughly prepared and officially recommended plans. The basic principles of this population policy may be summarized in three statements, all of which appear somewhat paradoxical since they contain an accumulation of, and not an alternative between, postulates otherwise always heretofore presented as choices.

1. The *value-premise* is that voluntary parenthood *and* a positive population policy can be brought together, and are not necessarily mutually exclusive. The neo-Malthusians focused their interest on the former, while population conservatives have centered around the latter. There is, however, no reason for such a choice. Voluntary parenthood should be insured to regulate the *size of individual families* according to their best interests, but community means should at the same time be mobilized so as not to *force that regulation to extremes*.

Only children welcome to their parents are wanted by the nation. Birth control has to be effectively spread to all groups of society in order to create a state in which only desired children are born, but at the same time social conditions have to be so modified that more children can be welcomed.

2. The *goal* must simultaneously consider both quantitative *and* qualitative aspects. The quantitative desideratum has been fixed at retaining if possible a constant population; an increase in total population is neither considered feasible nor desirable. This quota should not,

however, be filled by children undesired by their parents as was just mentioned, nor by undesirable children; quantity should not be bought by sacrificing quality. In order to avoid such defects, premiums to parents per newborn child cannot be resorted to, however effective such measures might be from a purely quantitative standpoint. All measures should be shaped so as to insure both the greatest improvement in health and other environmental conditions for the children themselves, and a reduction of the economic motive for extreme family regulation. As a corollary to this basic principle it follows that practical aid should, instead of being paid in cash to the parents, be paid in services to the children, offering rational consumption on a cooperative basis, tax-paid for children of all social groups, i.e., patterned after the public school system.

3. The *means* for a democratic population policy must include both educational influences *and* social reforms. Sheer moralization and exhortations "to do one's duty" to the nation are considered futile. Psychological attitudes may, however, be changed by education to foster a greater understanding of family values and greater capacity for living in family relations. On the other hand, economic reforms are necessary, patterned to assure that a larger share of the national resources be allotted to children

These two approaches inevitably interact and interlock: without education no family reforms can be voted by a people among whom childless individuals and "child poor" families already form the overwhelming majority; without social reforms no educational sermons on the value of larger families can humanely be given to the great mass of people. When the "normal" size of the family has to be fixed at four children in the majority of non-sterile marriages in order to keep population constant in the long run, it becomes apparent that as much as nine-tenths of any population cannot rear these children on approved standards of health and culture without considerable community support.

These are the foundation pillars of the new Swedish population program. I will try to give some idea of how this philosophy is being implemented as a scheme of practical reform, using the qualitative aspects as the frame of reference. The philosophy which matures out of consideration of these principles is simple enough, but its practical application to an existing social system is another matter. The list of social measures enacted or proposed in Sweden to put this program forward has grown quite formidable and complicated.

When the program was first envisaged and its effect on the quality of population had to be evaluated, it was taken as a practical value premise that the main social groups be considered of equal hereditary worth. Individual differences as to hereditary capacities were not found to group themselves in any way that would make it possible to isolate certain economic or social groups within the people and to say that they were characterized by higher or lower average hereditary worth. Only a small bottom layer of society could rightly be regarded as biologically inferior, but that group should not be classified within any of the large socio-economic classes. This may seem a bold assumption, but in a racially homogeneous people with a very mobile social structure, it seems to be valid. As a starting point for practical purposes it is at least far less dangerous than the opposite view which would call for encouragement of differential birthrates on biological grounds,—a proposition which the Swedish experts did not consider to be valid. The present necessity for differential birthrates on economic grounds is also being diminished by the sum total of various reforms.

The scope of negative eugenics is thus considerably narrowed. *Sterilization,* however, is utilized against a residuum of all social classes whose perpetuation is considered least desirable. A sterilization law was enacted in 1934, enforcing sterilization of persons suffering from illness of a grave hereditary character and themselves incapable of consent. So far sterilization operations have not exceed-

ed 250 annually; these have been performed mainly on mental defectives.

A supplementary sterilization law has been proposed by the Population Commission covering *voluntary sterilization* by individuals capable of consent. The indications here are more lenient. Sterilization is considered to be indicated when the defect of which there is risk of perpetuation by heredity is a grave one (mental or bodily illness, deformity, psychopathy or genuine epilepsy). Carriers who do not show the trait may be sterilized under this law but not under the previous one. Further recognized reasons for sterilization are found in cases in which persons would be incapable of caring for, or rearing children, social and economic insufficiencies being also taken into consideration as adding weight to other reasons for sterilization.

Having thus given the legal provision for excluding from procreation the decidedly undesirable group, a border-line group has next to be considered. This group is probably the most difficult to handle in any eugenic program, its heredity values being doubtful, though not enough so to indicate sterilization, but its social capacities being unfavorable to child rearing. It is officially planned, though as yet scarcely put into practice, to influence this group to severe family limitation by direct propaganda and instruction in contraceptive methods.

Together these two exceptional groups constitute only a small part of the population and that is the only field where differential eugenic methods are being contemplated. For the rest of the people a "natural harmony" will have to work itself out, both birth control knowledge and family reforms being accessible in the same degree to all social groups. This may raise the question as to what is being done for the rather important group with too large families under too poor conditions. Since we cannot conclude that they are biologically inferior to the rest of the population, and as in any event their children must be well protected, nothing else can be done in regard to their future fertility than to try to bring about a better correlation between standard of living and size of family through an active inter-play of birth control and social reform. Some signs of success along these lines are revealed in the well-known study by Edin, indicating a positive correlation in Stockholm between family income and family size, and also in the returns of the special census in 1936, showing increasing numbers of children in the highest income groups in the whole country.

*Birth control* information is being disseminated to the people in many ways, encouraged by the repeal last year of a law against contraceptives. First, sound family attitudes and parental answers to sexual curiosity in early childhood are encouraged. Sex education is made part of school instruction at practically all levels, including a knowledge *about* — not *in* — birth control in early adolescence. Through later schools and chiefly through adult education, which is widespread in Sweden, a knowledge of rational contraceptive techniques will be given. In the last instance individual consultation is to be made accessible everywhere. Interestingly enough, only in large cities is it planned to institute this program in the form of birth control clinics; in all other places the activity is to be carried on through the network of mother and baby centers, health officers, district nurses and district midwives. But far be it from me to give you the idea that all those are already good collaborators. Not even their professional instructions have as yet been revised.

All the positive reforms, which will be briefly outlined below, aim at improving health, education, and environmental conditions in general. Together they form a new system of prophylactic social policy, safe-guarding the quality of the population in advance and not merely partly curing its ills. Such a policy is considered to be to a much higher degree an "investment," and an investment in the human capital of the country, fully equal to or more profitable than investment in factories and machines and other property which "rust can corrupt and the moth consume."

It may be said that the health of the

mother is safeguarded through spacing of children and limiting extremely large families. In recent *laws relating to induced abortion* which came into effect in January, 1939, so-called mixed socio-medical indications for abortion are allowed, thus designating the "wornout mothers."

*Prenatal care* to every mother is guaranteed through a network of mother and baby clinics, available free to all social classes, as a result of a parliamentary act of 1937. At the same time a reform was carried through making all *delivery care* free of cost to all social groups, provided it is given by district midwives in the patient's own home or in a general ward of a hospital or maternity home, many more of which are being erected. This care is considered to be first-rate. In the institutions and also in the waiting-homes a maximum daily fee of one krona (25 cents) is charged for the food, which the patient saves by not being delivered at home. If to these reforms another is added (which so far is only proposed)—namely, to give *free preventive medication* and *food rich in protective values, vitamins, etc.*, on doctor's prescription to children and mothers through the mother and baby clinics, you have a scheme that safeguards the health of mothers and infants at the same time as it reduces the economic burden of having children.

That burden is further reduced by a *state maternity bonus* of 75 kronor to all mothers under a certain high income limit which has enabled 92% of all mothers to take advantage of it, and which is intended to cover extra costs at the time of childbirth (layette, etc.). For pregnant women in distress an innovation of the same year, 1937 (the parliamentary session of that year being called "mothers' and children's riksdag") allows a *subsidy or loan* from state funds of a considerably higher amount, 300 kronor, intended to cover living expenses during the three to four most critical months. The last-mentioned reform is specifically directed toward reducing illegal abortion. The new abortion law does not allow abortion solely on economic grounds but holds instead that the economic motives should be eliminated.

In another way also this whole scheme of maternity security is interwoven with other motives — the intention being to reduce infant mortality to the same level for the whole country that is now typical of the upper income classes in Stockholm: that is, from 4.72% to slightly over 1%. That would mean a gain of about 3,000 children annually; again a harmony of quantitative and qualitative considerations.

The health supervision of children does not end with infancy. Baby clinics are planned, but as yet are not in operation, to cover the whole pre-school period. Complete *medical supervision in schools* is also planned, but is not as yet a fact. *Dental care* is organized by the community with fees for children diminishing in proportion to the size of the family, the highest being 5 kronor ($1.25) per annum. Again: costs are lowered and quality secured.

The quality of the people, however, is not only dependent upon control of bodily health, but is fundamentally related to general living conditions; housing and nutrition being most important. In these budget items also the most far-reaching reforms are envisaged, already enacted for housing, but so far only governmentally planned for nutrition.

The paradox of an industrialized economy — the widening gap between income and size of family — is perhaps nowhere more drastically illustrated than in regard to *housing* where official statistics, if tabulated to bring out the point, easily show that the larger families must live in the smaller apartments. With the very low standard of housing which exists in Sweden as to size of apartment, actual overcrowding threatens most of the families as a consequence of the birth of children. Nearly a third of all minor children, and almost half of all children in larger families, i.e., families with three or more children, live in houses where there are more than two adults or four children per room, the kitchen being defined as half a room.

This menace to both physical and mor-

al health has, since 1933, been met by wide state subsidies of low-rent housing. The most direct attack, however, is part of the family reform program, dating from 1935. Building of apartment houses, one-family houses and rural homes for families with three or more children is specially subsidized and planned with regard to conveniences, playgrounds and so on for children. The state pays an annual discount on the standard rent according to size of family, starting with a 30% rebate for families with three children. This housing program has met with general approbation; about a fifth of the urban population with low incomes and large families has been rehoused, and the remainder of the building program is being timed so as to act as a reservoir of productive work for the next period of unemployment.

Getting a larger home at approximately the same rent as the former smaller one when new children arrive is not a personal gain to the parents but a reduction of extra costs. Thus, this program for rehousing the children is typical of the Swedish population measures. The same basic idea has shaped the program of a *nutritional policy*, by which certain surplus agricultural commodities would be bought for the children. It is proposed to realize this first through a free school meal for every child, thus guaranteeing a minimum health diet for all — utilizing butter, milk, etc., which are now being "dumped" in England with export subsidies. Supplementary to this plan, but not yet worked out in detail, is the proposal to create a two-price system for agricultural products; *not* one price for poor people and another for well-to-do, but one price for the childless with rebates for the parents of children.

The future population may thus be raised in quality as far as economic means may suffice; class differences not barring any child from an equal chance to develop his hereditary potentialities. Still more may be achieved through an *education* that utilizes to a greater degree the mental and personal capacities of each child. To a great extent this may be said to have already been formally achieved by a school system that allows great vertical social mobility; free schools, free university and professional training, etc. But much more may be done to complete this "democratization" of schools by free supplies, boarding homes for rural children, state subsidies to pre-school institutions, more correct placement through vocational guidance, etc., etc. Such reforms are in preparation. It may be that still greater qualitative improvements could be achieved by building up personalities through the educational system, with less stress on competitive and obstructive forces and more on cooperativeness and ability to work efficiently and live happily. In order to illustrate the "harmony of interests" which I have emphasized all through, may I also indicate that these same educational reforms are, or could be, coordinated with endowing the next generation with greater appreciation of family values and greater ability to handle family relationships — thus again working for a positive influence in getting the *right number of children in the right families*.

I should be very sorry, indeed, if this account were to be taken as just another attempt to advertise an idealized Sweden. My picture should not be interpreted as telling of beautiful perfection, but only of honest statements both of our deficiencies and hopes and of a concerted striving to make things better for this generation and for future generations.



## BIRTH LIMITATION IN SWITZERLAND

DR. Zurukzoglu, in cooperation with a number of well known Swiss scientists, mostly physicians, discuss in a volume of 346 pages the problems in Switzerland related to measures for the purpose of reducing offspring among

those unfit for parenthood by reason of disease, hereditary defects or asocial characteristics.* The collaborators are recruited from among the leaders in the various medical disciplines, from sociology, from the clergy and from social welfare work.

The usefulness, purpose and effectiveness of the various educational and other measures now employed for the purpose of reducing the physically and mentally defective element in the population are discussed at length, e.g. marriage and personal counselling, birth control, abortion, sterilization, segregation and hospitalization. Last, but not least, are the laws prohibiting mental defectives from contracting marriage. The lack of community interest in the enforcement of these laws makes this measure practically ineffective, since according to more than one investigator, objections to the marriage come up before the rightful authorities only in a negligable number of cases.

An appeal is made throughout the book to physicians, social workers, the clergy and the educators for a wider education of the public on matters of hereditary aspects of a variety of diseases and the dangers and ill-effects of inbreeding in many of the rural sections. Such warnings are particularly important in the mountainous regions where thyreopathic idiocy, cretinism, etc., are found relatively often.

### Grounds for Sterilization

The most important question the collaborators were asked to consider in their discussions was: "Should statutory regulations be enacted in Switzerland for the sterilization of defective individuals, in the interest of the community, on eugenic and social grounds?" It is the consensus of opinion, that for the present, sterilization can best be handled by means of administrative procedure, which is, and has long been effective for the protection of the interests of the patient, his family and the commonwealth. This administrative procedure, which can still be extended considerably, is for Swiss purposes preferable to regulation by statute. The procedure is understood to be a close working together of the municipal authorities, the state health and welfare authorities, the family, and the legal and medical professions, in the manner of the private physicians' relationship to the patient. A written consent of the patient or that of the rightful guardian, constitute, with the complete social and medical history, the documentary material needed for the protection of the physician from criminal prosecution. The Swiss authorities, the legal and medical professions look upon sterilization on eugenic grounds as a matter coming within the domain of the Medical Practice Act, and is for that reason primarily the responsibility of the physician in relation to his patient.

This attitude accounts for the fact that only one of the twenty-five cantons has enacted eugenic laws, the Canton de Vaud. Under mandatory provisions, these laws discriminate against women, since it is extremely difficult to get the needed consent for the operation from men.

In some 80 pages the author brings a very painstaking review of the important legal documents related to eugenic sterilization throughout the world, the texts of the existing and proposed laws, as well as the pronouncements on sterilization in regard to the Roman Catholic and Protestant points of view. The book also contains a very extensive bibliography of the pertinent literature on hereditary aspects of a variety of diseases, on the legal medical aspect of the question, as related to the set-up of the Swiss Commonwealth, and on sociological topics.

MARIE E. KOPP

*ZURUKZOGLU, ST. *Verhuetung Erbkranken Nachwuchses.* Benno Schwabe und Co. Basel, 1938.

# EUGENICS AND CHILD STUDY

SIDONIE MATSNER GRUENBERG

THE eugenics movement and the child study movement have in common a vision of human betterment by deliberate human action. Both seek to use our knowledge to control the blind forces of nature.

Eugenics seeks human betterment by planning for a continuing improvement in the inherent qualities of the population. The child study movement seeks human betterment by trying to improve human relations—first the relations among the members of the family, and eventually relations in society at large. These two movements are in a very real sense supplementary. We are not now renewing the old debate on the relative importance or efficiency of heredity and environment. Scientists have long since recognized the fallacy upon which this issue rests; and everybody else has long recognized the futility of the debate. For the present we have to consider that, with the exception of certain extreme deviations, the problem for the population at large lies in giving our heritage a chance to do its best by assuring for all the basic conditions for decent living.

As the new knowledges and the new technologies have altered our conception of the good life, we have become increasingly dissatisfied with leaving things to fate or to nature. We have questioned every tradition, every detail of life. We no longer have to do as people have always done: we have multitudes of choices. Men and women in increasing numbers are wondering whether they should marry, whether they should have children, or more children. It is not merely those who are frankly indifferent to children, or who dislike children, who doubt and wonder. On the contrary, it is for the most part those who care that raise the question, those who are in conflict: those who want children, yet fear to have them.

Many kinds of reasons are given for such fear. There is economic insecurity or inadequacy. There is sometimes doubt about health, but increasingly the existing state of the world is brought up as a source of misgiving. What's ahead for children in such a world? More particularly, what's ahead for one or another minority group, or for underprivileged majorities? These are serious considerations and indicate a degree of foresight and of responsibility which must be recognized as socially desirable. From a eugenic point of view, however, such questioning holds no assurance of race betterment, for the preponderance of births is still among those who ask no questions, who leave everything to fate, or to well-disposed neighbors, or to charitable agencies.

It would appear desirable to have a higher birth-rate among those who are more intelligent and more responsible. There is one consideration, however, that raises doubts; for these men and women seem also in large proportions to be the ones who are most afraid of the future. In contrast to the ignorant and indifferent, with their recklessness, are the men and women in whom "the native hue of resolution is sicklied o'er with the pale cast of thought." From the eugenic point of view we have to ask: What kinds of guidance, what kinds of services will tend to raise the fertility of this part of the population? What kind of education, what kind of relationships will increasingly favor intelligence, responsibility, goodwill?

We know now that this section of the population is not going to be greatly influenced by trivial grants-in-aid for hospitalization or scholarships. But we may assume that it can be influenced by an education that increases the appreciations, the enjoyments, and the effectiveness of home-making. For the home does lay the foundations for decent relationships with others; for purposeful and well-considered guidance of life; for responsibility; and the pattern of home needs more than ever to be deliberately questioned and planned.

What makes family life so difficult for moderns? First, it seems to me, is the industrialization of our lives. This has taken out of the home almost all the functions through which men, women, and children could, in former times, express themselves and act upon one another as persons, through which they could educate and enrich one another. Many of the functions have been taken over by specialists and are being performed much more efficiently, so that it is becoming difficult for adults to justify what is left of their home activities in the old terms of useful work.

### Short-Sighted Emancipation

Another great strain upon the modern family comes from emancipation of woman, with the taking on of new obligations in addition to parenthood, often by choice. This liberation, which promised to enlarge our opportunities so gloriously, stirred the enthusiasm of a whole generation of girls and young women, but left them in the end cheated. For the education which that generation received was patterned after the schooling of boys for various trades and professions and public affairs; and it was given in a manner which not only aroused impossible expectations, but unfitted the girls for their later roles as women. While it was necessary at some stage to open to girls the opportunity to enter into aspects of culture which the males had monopolized, it appears now to have been shortsighted to offer them merely a duplicate, sometimes diluted, of the schooling offered to boys, and so to educate them away from marriage and homemaking. It is true, of course, that this emancipation involved a necessary rebellion of women themselves against arbitrary restrictions and discriminations; but regardless of whose "fault" it was, it did in general work blindly, as rebellions often do.

Another factor that makes modern family life difficult is the very reduction in the number of children. We might expect that, with fewer children in the home, the parents would get better results. Very often the contrary is the case. This is because the parents discharge all their emotions upon the few children. Unless there are adequate outside interests, especially for the mothers, the only child is notoriously apt to suffer.

We have then a generation of self-conscious parents. Men are aware that modern resources makes possible high achievement in personal living, and also that parenthood involves obligations for making available to the children the best of everything. Women are aware that they have been granted the inestimable privilege of higher education and access to the lore and wisdom of all the ages, as well as opportunity to live full lives—like men.

### Motherhood Still an Art

Somehow the promises made to our youth are not now being fulfilled. A great many women are perplexed, and they are making their own lives and the lives of their husbands and children very difficult, by trying to use their training and abilities according to masculine patterns. They have received their education in neat little parcels, with definite price-tags or grades attached. Then they are astonished and hurt to find themselves unable to manage their tasks as mothers with the same high competence. Here the objectivity and hard efficiency are entirely unsuited.

Women can and should, of course, learn a great deal that is valuable about the care and guidance of children, but the skillful managing of technical details will not make them competent mothers. For parenthood, in its very essence, requires seeing the child as a whole personality and being emotionally concerned with the child's changing needs.

In modern family life, which has become very much enriched in many ways as well as simplified in others, we must remember that the moment we are free to make a choice we have also greater responsibility. Moreover, we make our choices at one stage, but reap our regrets only years later, when we are different personalities. This is particularly true for women today, who have apparently the choice between marrying and remain-

ing single, between having children or not, or how many, or when. Such freedom demands the making of important decisions; and these decisions involve tremendous responsibility.

### When to Have a Child?

Is there ever a particularly convenient time to have a child? If a woman is already absorbed, whether in special technical work, in exciting social activities, or in important voluntary service, when is a good time to put these things aside for a baby? Whenever a decision is made, it is in relation to what is immediately in sight—work, income, vacation, moving to another house—all important, to be sure, but seldom all of enduring significance.

In our own times, the home pattern has been so much altered that very few of the young people have had a chance to see a clear picture of the continuity of family life over the years. They cannot see that the life of the individual, and more strikingly the life of the family, passes through a succession of phases. The bride, the young wife, the mother of children in the growing period, the mother of children already grown—these are sufficiently distinct persons to preclude a single decision being made once for all of them. The man changes too, of course, but as his life is so largely organized around his outside work the differences are not so sharp, nor so far-reaching.

Making a decision in regard to a family is not merely something for today or tomorrow, it is a vital part of creative adjustment, which is a continuous day to day process. Here again we find that young people have been confused and misled to believe that it was freedom alone that they had gained. We have more responsibility too, and for that we are totally unprepared, for neither our traditional procedures nor our unencumbered impulses tell us just how to work out the needed adjustments.

### Revising Birthrates Humanely

As we see our population changing, we are aware that the distribution of birth rates, of marriage rates, of death rates will affect the character of our people a generation hence. We cannot pretend to know what classes of persons should be encouraged to have more children. We cannot tolerate the determination of a differential birthrate either by a self-constituted authority or by an official agency. We have to ask, what patterns of living are likely to lead to improvement, not alone in the immediate and narrower euthenic sense, but in the long run, in terms of selective survival—which is the concern of eugenics.

It seems to me that we have to seek, at least in the immediate future, for a pattern that demands of the home the greatest responsibility for the physical and spiritual care of children, but at the same time insures the home opportunities for attaining competence and access to all essential resources for decent home making. This means of course not any ideal or any abstract home, but particular men and women.

We may reasonably hope that through the education of parents in what positive understanding we have as to the nature and the needs of children we may achieve two important results. First, we should expect a progressively better rearing of children, to produce individuals better adjusted to the complex social life in which they are to take part, better adjusted to the difficulties of the home, and to the difficulties of weaning themselves away from home. Second, we should expect a sounder attitude of young men and women toward the satisfactions and responsibilities of parenthood, a deeper appreciation of childhood, and a wider recognition of the need for children on the part of men and women.

### Children Need Parents—and *Vice Versa*

For just as children need parents, healthy people need children—and want children, often in spite of adverse circumstances. It is necessary to help young men and women accept this desire for children as legitimate and worthy. Children contribute to the growth of the personality and yield satisfactions to their parents, even if in many cases they bring their worries and troubles and disap-

pointments. Parents find in children extensions or projections of the personality in ways that are potentially of benefit to both, and of value to society at large. These ideal outcomes may rarely be attained to the full in actual living. But we may well assume that if we can increase the competence and responsibility of parents, succeeding generations will show a larger proportion of effective parents and of socially adjusted individuals.

Educating parents means undoing a great deal, re-educating. By trying to educate masses of children and young people for parenthood and home making, we may at least hope that we can do constructively a great deal that will not need later to be undone. And our young people are not getting the best we can give them. In recent years very many of them have become too skeptical to listen dutifully to the old line of success story. They have learned something of economics and of statistics, and they can figure out for themselves what their chances are on the old formula by which everybody who is good and minds his own business becomes president, at least of the county bank.

**Youth Betrayed**

To me the most bitter commentary on our failure to meet the problems of youth is the message written on classroom blackboards by leaders of departing college seniors: "WPA, Here we come!" We cannot treat our adolescents as if they were merely a reserve army, with nothing to do but wait for some remote call to duty. It is not merely that these millions are made unhappy by the feeling that they are not wanted or needed. The important point is that millions of adults in all sorts of responsible positions fail to see how urgently needed these boys and girls are for our own survival. For no civilization can endure that simply puts its young people on ice against a possible future market. It is futile to talk of social progress or of better education or of community welfare, or of economic planning, or even of social survival, and disregard the need of the adolescent to take part constantly and increasingly in whatever we consider socially significant.

Today only the totalitarian nations are systematically serving the needs of youth by utilizing their energies and enthusiasms to further common ends; but they are doing so through forms of regimentation and indoctrination that violate democratic ideals. Yet nothing is more important for democratic nations than systematic efforts to meet those needs. This problem is the greatest challenge to the imagination, ingenuity and boldness of our educators, our parents, our community leaders, and our statesmen.

If we believe that the family is a vital factor in the life of the individual and of society, then our education will be permeated with ideas and sentiments that lead to placing the family at the center of values and purposes. Then we should expect parents not merely to make some concessions to their children or "live for" them, but to orient themselves so that they live with their children. Then children, growing up in families, would get a picture of the family as a normal and satisfying way of living, not a disagreeable necessity or a burden of hardships to be borne through compulsion or a mysterious "duty."

If the inherent possibilities of our population are to manifest themselves in living, we shall have to insure for the family certain essential services — in education, in health, in recreation, in housing —that will favor child raising and family life. We must learn to look upon the many kinds of activities and enterprises carried on in the community as adjuncts of the family. Instead of managing our various ventures as if they somehow existed in their own right, with a franchise to subordinate the family and its members to their several interests, we must justify them by what they do to make safer and sounder the life of the family — and so the life of society and of the race. For the stakes of our great experiment, like the stakes of war and of diplomacy, are men, women, and children — and these thrive only in the family.

# SOME IMPLICATIONS OF CURRENT DEMOGRAPHIC TRENDS*

## For Birth Control and Eugenics

FRANK W. NOTESTEIN

PERHAPS the most important development in modern times has been the enormous expansion of population. In the middle of the seventeenth century the world's inhabitants numbered only about five hundred million. There is no reason to suppose they had ever been more numerous throughout the entire history of mankind. In the following three hundred years there was a terrific upswing which carried the total number of human beings to more than two billions, an increase of nearly fourfold. Three centuries is a short time in the history of a species. In the living history of a civilization it may be a very long time. For the West the years since the middle of the seventeenth century have been long. In them our ways of life have changed from those of essentially rural handicraft societies to those of highly urbanized civilizations in which the machine plays a dominant part. This new world, which is the only one we know with any sense of reality, has remodeled our institutions, economies, and habits of mind. Its dominant note has been expansion; territorial, intellectual, technical, and numerical. Three unique centuries have left deeply imbedded the idea that population growth is normal. This fact is the first and perhaps the most important one to remember when we attempt to gauge public reaction to current population trends.

Apparently the rapid growth of population came primarily from a steady decline in the death rate, due in the first instance to a period of relatively stable government and peace, then to the increased production of food yielded by agricultural innovations, and followed shortly by large increases in production brought about by the Industrial Revolution. Finally modern sanitation and preventive medicine made spectacular contributions to the control of mortality. In the middle of the seventeenth century the average expectation of life at birth probably was well below 40 years. Todav it is somewhat over 60 years for our white population.

Obviously, such declines in mortality had eventually to be followed by corresponding declines in fertility, or the world would have been too small to accomodate its people at planes of living that would make low death rates possible. In Europe the decline first began in France at about the end of the Napoleonic Era; in the other countries it began shortly after the middle of the nineteenth century. In the United States it was underway at least by the first decade of this century, but it started from almost unheard of heights. In colonial times the scarcity of population offered every inducement for the rearing of large families. The decline has continued virtually without interruption to the present time. By 1930 the average woman living through the childbearing period was producing only 2.2 children instead of 7.8 children as in the decade 1789-1799.[5]

This decline in fertility has not gone on at a uniform rate throughout the various strata of society. Detailed evidence reaching back to the nineteenth century is fragmentary. In England the record is fairly clear. At the middle of the century the social-economic classes did not differ sharply in fertility. Then the birth rates began to drop, first and most rapidly in the "upper" social-economic groups. As a result class differences in the fertility of marriages contracted in the last decade of the century were more than two and a half times as large as those for mar-

*From the School of Public Affairs, Princeton University, in cooperation with the Milbank Memorial Fund.

riages contracted shortly after 1850. Somewhat similar trends in this country appear to have increased the differences between the fertility of the poor and the well-to-do through the first decade of the century. Similar trends were increasing the spread between birth rates in the country and city. Apparently birth rates fell first and most rapidly in the large urban and older industrial centers of the Northeast, spread to the newer industrial areas of the Middle States, and to the farms. Briefly it may be said that present differences in the fertility of our important population groups reflect in large measure a lag in the infiltration of the small family pattern from community to community and class to class.

### Fertility Differentials

Today differences in fertility are large. For the United States as a whole, fertility has now dropped slightly below the level required for the maintenance of a stationary population, but this general average conceals wide differences between sections and classes. In the period 1930 to 1935, fifty-five per cent of the Nation's natural increase, i.e. excess of births over deaths, was contributed by that third of the population in the principal agricultural areas. Within these areas the largest contributions came from the poorest sections. In 1930 the fertility of the population in agricultural problem areas was more than 75 per cent above that required to maintain a stationary population.* In the worst of the areas, where more than sixty per cent of the farms are to be transferred from agricultural to other uses, the population was reproducing rapidly enough to double its numbers in one generation. In the less poverty stricken areas but ones for which the plane-of-living index was below the national average, fertility was lower, but still well above the level required for permanent replacement.

On the other hand in counties for which the plane-of-living index was above the national average the fertility of the population was substantially below the replacement level. These counties were predominantly urban. In 1930 cities with populations of 25,000 or more inhabitants had an average fertility only 85 per cent of the amount required for replacement. In one quarter of those cities fertility was less than 75 per cent of that required for permanent replacement. Within each city fertility was highest among the poor, uneducated, and unskilled, and lowest among the well-to-do educated population engaged in business or the professions. The Nation's new-born citizens are somewhat fewer than the number required to maintain a stationary population, and they are being recruited heavily from rural areas, particularly from the most impoverished rural areas of the South and West.

There are a few signs that these wide differences are beginning to narrow somewhat. Recently in the native-white population birth rates have been declining most rapidly in the high fertility areas of the South, while those in the Northeast, which began to fall long ago and are now very low, have tended to level off.

### Changes in Class Differences

There is also some suggestion that class differences are beginning to narrow or even reverse. Recent data for five cities collected by the National Health Inventory[1] indicate a higher fertility in groups with incomes over $5,000 than in those with incomes between $3,000 and $5,000. Similarly 1930 census data for native white couples married five to nine years show[3] that the average number of children was somewhat larger in families with homes worth $10,000 or more than in those with homes worth between $5,000 and $10,000. It is important to note that there is no evidence that such reversals are due to an increase in fertility in any group. Probably they are only due to the fact that birth rates have not fallen as far in the really well-to-do groups as in those in moderate circumstances.

How far this trend toward a closing

*This statement, like many of the following ones, is based on material presented in: the Population Report of the National Resources Committee.[4]

or even reversal of differences will go is of course conjectural. There is no proof that the small family pattern will run its course through all classes and sections. It does seem likely, however, that the birth rate of some of the most fertile communities and areas will drop below their present levels. If they do, differences almost certainly will narrow and we shall have a further decline in the birth rate for the country as a whole.

No adequate discussion of the causes underlying these trends can be undertaken here. Many of them center around the development of a highly urban society. Costs of rearing children have risen while opportunities for them to make economic contributions to the family have disappeared. The home has lost many of its economic functions to a competitive industry that is employing its sales effort to create new demands for goods, amusements, individual freedom from domestic responsibility, and the achievement of social status. Most of these new wants compete directly with the child both in the family purse and in the family interest.

More important, for present purposes, than the underlying causes of recent trends in fertility are the immediate causes, or more properly the immediate means by which they have been achieved. The evidence, fragmentary but compelling, all leads to the conclusion that trends in the birth rate have come about chiefly through the adoption of birth control. Many other factors may have been involved but they have been relatively unimportant.

What are the implications of this fact? In the first place it means that we must credit contraception with permitting us to avoid a terrifically overcrowded world in which present low death rates would be impossible. Second, we must charge it with a large part of the existing differences in fertility that are resulting in a population drawn heavily from classes and sections with the least economic opportunity. If that pattern is transitory and the small family pattern actually does not run throughout all sections of our society it may have serious consequences, but it probably will do no damage to our culture and stock that time will not heal. If, however, we continue a permanent recruiting of our population from groups with the least economic opportunity serious damage may be done. There is no proof that the damage will be genetic. The point needs no emphasis here for the American Engenics Society clearly recognized that there is no proof of substantial differences in the genetic quality of our large social-economic and sectional classes. The damage would be none the less real. Few thoughtful persons are happy at the prospect of drawing our population heavily from families whose incomes provide inadequately for the healthy development and education of their children. The matter is the more serious in that such families are heavily concentrated in areas whose slender resources afford wholly inadequate educational opportunities and restrict the entire cultural life of the community.

We must face the fact that the means for the voluntary limitation of parenthood are available principally in the relatively well-to-do urban communities. Such a situation has no place in a democratic society. The birth control movement deserves high praise for the recognition which its new program gives this fact and on its resolution to devote new energy to the problems of the poor rural areas particularly those of the South in which safe, simple, inexpensive, and effective contraceptives available to all classes are urgently needed. The American Eugenics Society can heartily cooperate in meeting this need for its position is based on the proposition that only when such contraception is available to the entire population will genetically inferior persons be able to limit their own fertility, and a constructive eugenic program become possible.

### The Birth Control Movement

It has been pointed out that rapid decline in fertility has developed largely through the instrumentality of birth control. What part has the movement itself played? Of course any precise and dem-

onstrable answer to this question is impossible. Undoubtedly the movement has been of first class importance. It has done much to educate the public, to formulate public opinion, and to stimulate governmental action. Its clinical workers have made invaluable contributions to the development of techniques and the formulation of standards. Its clinics have been powerful agencies for focusing community enthusiasm and education. It must be admitted, however, that clinics have been relatively unimportant in the direct dissemination of contraception. Birth rates started to drop, through the instrumentality of contraceptives that required none or the simplest equipment, long before there were any clinics of consequence. In recent times the important dissemination of contraceptives has been commercial.

The moral for the future seems clear. Extra-mural clinics are not now and are not likely to become important agencies for the dissemination of contraceptives. They have and will continue to have other and important functions. However, if clinical procedures are to obtain wide acceptance in the lower income groups where the need is urgent, they will do so only when contraceptive service becomes an integral part of fully developed official maternal health programs designed to meet the needs both of the urban and rural populations. Clearly the birth control movement should continue its efforts to foster such programs. Before they can succeed there must be further research into the means of meeting the needs of the poor and further education of both the public and the medical profession concerning the importance of meeting those needs. Pending the achievement of such programs the distribution of contraceptives will remain largely commercial. If the public is to be protected from ineffective or even dangerous commercial products, further work on standards and a measure of public regulation will be necessary. It is to be hoped that the birth control movement will continue its leadership in all of these fields. Such a program may do much to bring the voluntary control of fertility to all classes of the population. If it does, it may eliminate the most dangerous differentials, but it will also bring a further general reduction of the Nation's birth rate.

### Population Growth

A further serious reduction of the birth rate will do much to stimulate the already incipient underpopulation scare. Birth rates of many European nations are seriously below the level required for the permanent maintenance of a stationary population, some of them by more than 25 per cent. In this country fertility is already slightly below the level required for permanent replacement. This statement means that if present rates of fertility and mortality remained unchanged the population would eventually decrease in size unless recruited through immigration. Actually even with present rates it will continue to grow for some years because the high birth rates of the past have left us with a large proportion of the population in the childbearing ages. When these groups become older they will not be replaced by groups of equal size, and the birth rate will drop, the death rate rise, and our natural increase will turn into a natural decrease.

Exactly how long our population will continue to grow, of course, no one can say. Current trends indicate that we shall approach the turning point between 1960 and 1980, probably nearer the former than the latter date. After that, barring an actual increase in fertility, a decline will set in, for the age composition of the population will have become less favorable for reproduction.*

### Age Composition

More important than the actual change in the size of the population is the shift in its age composition which these trends will bring. We are already seeing the effect of the dropping birth rate. Between 1920 and 1930 the num-

*These estimates are based on the work of the Scripps Foundation presented in the Report[4] of the National Resources Committee cited above.

ber of children between six and nine years of age, roughly those eligible for the first three years of school, increased by about one million. Between 1930 and 1940 they will decrease by about one and a half millions. On the other hand the number of persons 65 or more years of age will probably increase by one and three quarters millions between 1930 and 1940, by about two and three quarters millions between 1940 and 1950, and by perhaps three and two-thirds millions between 1950 and 1960. These estimates point to the inevitable aging of the population that the falling birth rate has brought about. Already they are attracting the anxious attention of educators, of students of old age security, and of certain industrialists. They will receive nation-wide attention when the results of the 1940 census begin to flood the press and popular journals.

What students of population think of these trends is not very important. What the public will think and how it will act may be very important, particularly to the birth control and eugenics movements. In Western Europe where the decline of the birth rates have been sharper than in this country, there have been serious reactions. New legislation and new regulations have restricted the dissemination of contraception. Several countries have undertaken programs involving substantial rearrangements of their national economies designed to stimulate fertility. Taxes on the single, marriage loans, bonuses for large families, and wage scales adjusted to the size of the family have been adopted in several countries and are being considered in others.

### Dangers of Panic

Before many years this country promises to be facing a similar population situation. The public reaction may be even more severe. Growth, development, expansion — these concepts are so deeply ingrained in our national temper as to be thought of as peculiarly American. With such traditions public reaction to a shortage of young people and an increase in the aged may be severe. These trends may become symbols of stagnation and decadence. Moreover, it is not characteristic of the American people to be aroused and do nothing. Our dynamic tradition is to do something and do it vigorously. An aroused public aware of its population problems offers a unique opportunity for the eugenics and birth control movements to secure a hearing for their programs. But unless their programs are intelligently conceived and ably presented a national cry for action may lead merely to repressive legislation against the dissemination of contraceptives.

If such repression comes it will result in a widening of birth rate differences. We shall have another bootlegging problem. The well-to-do and to some extent all the people in our urban centers will be able to obtain reasonably adequate contraceptives, but the poor and the population of rural communities will by and large of necessity conform. Prohibition of contraceptives would yield a higher birth rate by exacting more children from the classes least able to bear the burden and to equip their children to become effective citizens.

In view of current trends that have, I believe, both fortunate and serious aspects and particularly in view of the probable public reaction to those trends, the birth control movement will be wise to examine its policies critically. For our present demographic situation it is too single-mindedly occupied with one aspect of its proper field, failing to realize perhaps that no society even under favorable mortality conditions can maintain itself without a significant proportion of large families. This fact is interestingly shown by Lorimer and Osborn.[2] After making allowances for women who do not marry, for marriages broken by death or divorce, for sterility and limited fecundity resulting in only one or two children, they present a hypothetical distribution that would yield a self-replaceing population. This hypothetical distribution is then compared with the distribution found by Davis for a series of American wives who were mostly college graduates. The hypothetical distribution calls for the birth of four chil-

dren by 18 per cent of the women instead of by 12 per cent as found by Davis, for five children by 15 per cent of the women instead of four per cent as found by Davis, of six children by six per cent of the women instead of one per cent found by Davis. Other distributions would yield a self-replacing population, but all of these would require that about 40 per cent of the married women bear four or more children. At present, as a nation, we are obtaining nearly enough large families to maintain a stationary population, only because freedom to limit fertility is withheld from large populations in our most poverty stricken areas. If this freedom is brought to those populations the birth rate will fall sharply below the replacement level unless there is a compensating rise of the fertility in other sections of our population.

Meantime there are many couples who want children and could have them if they had proper medical attention, or if parenthood entailed less severe economic penalties. The situation points clearly to the need for much greater emphasis on the positive aspects of the freedom of parenthood by both the birth control and eugenics movements. Freedom of parenthood which means freedom to limit but not to express fertility, is at best hollow freedom. Both kinds are essential to a democratic society that intends to maintain its culture and stock through the voluntary acceptance of the obligations of parenthood. In the face of current population trends, movements that wish to retain the right to extend voluntary limitation of parenthood to all classes should also accept the responsibility of fostering positive freedom of parenthood. The need for an extension of programs in this direciton is real and the time is strategic.

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## Genetic Linkage

Mather, K. The Measurement of Linkage in Heredity. pp. ix + 132. Chemical Publishing Company of New York, New York. 1938.

A MOST useful compilation of work methods for investigators of genetic linkage is now available in literally a pocket-size edition. Based largely upon the recent work of English scholars, and particularly upon that of the figure who towers highest in the field — R. A. Fisher — the book deals with quantitative methods for detecting and estimating linkage. Methods for dealing with disturbed segregations, and for combined estimation and testing heterogeneity are included. Especially valuable are the sections on planning experiments, designed to aid the investigator to formulate in advance how much and what kind of data are essential to clear-cut solutions for his problems.

In the chapters on human genetics, Mather effects a consolidation of the complicated statistical techniques that are necessary to compensate for the usual lack of available information regarding the genetic make-up of the parent generation. Applications of Fisher's

"$u$" formulae are outlined and illustrated, and the relationship of these formulae to the chi-square test of goodness of fit is touched upon — a valuable supplement to the original Fisher articles.

In his discussion of the method of "like" and "unlike" sibling pairs, which he attributes to Penrose, although Penrose was not the first to employ it, he rightly points out its lower efficiency in terms of information yield, and recommends that "it should not be used unless the parents cannot be obtained or else the collection of pairs of sibs is so much easier than the collection of whole families, that vastly increased numbers of observations can be made." He does not mention, on the other hand, that this method is sometimes useful when the genetic constitution of the parent-generation is unascertainable because of lack of information as to the mode of Mendelian transmission of the traits undergoing test — that the method may be used, in fact, to clarify the transmission mechanism of traits arising from more than a single unit-factor.

The book is distinctly a treatise of the present, and its British emphasis is perhaps understandable in the light of the brilliant work which the Galton Labaoratory is producing. The reader may share the judgment of the reviewer, however, that the volume would gain in practical value as a tool for craftsmen if some of the historical roots and progressive developments — even those of no longer ago than the beginning of this decade (*vide* Bernstein, 1931) — were at least briefly traced.

Barbara S. Burks
*Carnegie Institution of Washington*

## The Materials of Human Arithmetic

Proceedings, International Population Congress, Paris, 1937: 8 volumes, 1410 pages. $8. (Prices of separate volumes from Population Assoc.) — *Hermann et Cie, Paris,* American agent, *Population Assn. of America, Victor Building, Washington, D. C.*

According to the last Statistical Yearbook of the League of Nations there were 2,116 million people in the world on July 1, 1936. Any such estimate is necessarily inexact since it includes an estimated 498 million people in territories not covered by any official census during the Twentieth Century. More than half of the people of the world live under more or less primative conditions, and are still characterized for the most part by rapid natural increase except as this is checked by wars, famines and plagues. Studies in British India, intensive surveys in selected areas of China, and some other investigations throw light on population trends in these areas; but far too little is known about the demography of this "other half" of the human race.

Meanwhile within the European sphere of civilization there is a general tendency toward cessation of population growth and natural decrease. This is already manifest in the excess of deaths over births in France; but the intrinsic reproductivity of many other countries is now lower than in France. This tendency, along with the general advance of social science, has led to great increase of interest in population studies and is leading to important developments in population policy.

A comprehensive survey of these developments is now afforded through the publication of the Proceedings of the International Population Congress in Paris, 1937. These Proceedings contain over 200 papers by scholars from many countries, and the subjects treated range over the entire field of the methodology and findings of population research. The papers are presented in English, French, German and Italian, with a brief synopsis of each paper in French.

The series begins with philosophical and mathematical treatments of population theory and methodology. This includes a critique of methods of measuring net reproductivity by Bunle, an analysis of results obtained by application of the logistic curve and other methods of population measurement by Lotka,

and a variety of contributions to concepts and techniques in various fields of population study. The essays on historical demography include four which deal with the population of the ancient world.

The range of topics may perhaps best be indicated by a few titles selected at random: Economic Fluctuations and Marriage Frequency (England and Wales), The Relative Amount of Ill Health in Rural and Urban Communities, Australian Population Problems, Differential Fertility in India, Die neue deutsche Bevölkerungsentwicklung, Zur Frage der Häufigheit von Erbkrankheiten, Heredity and Environment, A Demographic Study of 38,256 Rural Families in China, Le Movement Naturel de la Population Néerlandaise.

A survey of these volumes, in comparison with the proceedings of previous congresses under the auspices of the International Union for the Scientific Investigation of Population Problems, reveals the rapid advance of demography in methodology and scope during the last decade.

FRANK LORIMER
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